The Regional Municipality of
Hamilton-Wentworth

Solid Waste Management Study

Report on Final Recommendations and Response to Public Input

Proctor & Redfern Limited

February 1976

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Proctor & Redfern
Solid Waste Management
Study

The Proctor & Redfern Group

Proctor & Redfern Limited
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February 17th, 1976 Project EO 74181

Mr. W.A. Wheten, P. Eng.
Commissioner of Engineering
Regional Municipality of Hamilton-Wentworth
P.O. Box 1058
HAMILTON, Ontario
L8N 3R4

Dear Sir:

Hamilton-Wentworth Solid
Waste Management Study

We are pleased to submit herewith our report on our final recommendations for a Solid Waste Management System for the Regional Municipality of Hamilton-Wentworth.

The terms of reference for the study suggested that the design period should be 20 years. Since the time of drafting the terms of reference, the Province of Ontario has announced its resource recovery goals. The Provincial goals envisage a network of reclamation and waste processing plants that will be substantially complete by 1990. In order to conform to the Provincial programme, and in recognition of the present rapid rate of advancement in the field of solid waste management, it is our recommendation that the mechanical components of the proposed Regional system be designed for and debentured over a ten year period. We recommend, however, that sufficient disposal space should be purchased for a twenty year period. If this recommendation is implemented, following the installation of a recovery plant the balefill site would be used for the disposal of residue and its life would extend beyond the nominal twenty years presently envisaged. The recommended system is therefore, flexible enough that it can accommodate the addition of any foreseeable solid waste management system.

Continued .....

A further advantage of the recommended system is that it will provide a complete back-up system to any future more sophisticated solid waste management process. It is inevitable that such a process would not be operative one hundred percent of the time and during periods of down time the baler system could be used to compact and transfer the material in a fashion that is environmentally acceptable.

Our last report brought our preliminary recommendations into the public arena. The public input that took place has been considered in some detail, and the changes to our original recommendations are partially as a result of that process. It would appear that our final recommendations will resolve at least some of the major concerns raised earlier this year. In this report we have also attempted to respond to the individual concerns expressed in the written briefs received by the Region.

We would like to thank you for the opportunity of working on this study and would be pleased to discuss this report with you at your convenience.

Yours very truly

The Proctor and Redfern Group

R. Tait, P. Eng.
Branch Manager.

W.D. Goodings, P. Eng.
Associate.

REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH

REPORT ON FINAL RECOMMENDATIONS AND RESPONSE TO PUBLIC INPUT

Project E.O. 74181

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Consulting Engineers and Planners
20 Hughson Street South, Hamilton, Ontario
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February 1976

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1. INTRODUCTION

The purpose of this report is to detail our final recommendations relative to the Hamilton-Wentworth Solid Waste Study, to provide details of the logic used to arrive at the recommendations, and to respond to the public input received at the public meetings in Glanbrook and Ancaster and in written form following the placement of an advertisement in the 'Hamilton Spectator'.

We have not attempted simply to refute public criticism, but instead we believe we have responded honestly to the major areas of public concern. The amendments to the recommendations contained in the Sixth Interim Report are partially as a result of public input.

2. BACKGROUND

In 1972 the City of Hamilton, the County of Wentworth and the Waste Management Branch of the (then) Ontario Department of the Environment jointly engaged Proctor and Redfern Limited to carry out a study with respect to the status of solid waste management systems in the County of Wentworth and the City of Hamilton. The terms of reference for this study are shown in Appendix 'A'. With the formation of the Regional Municipality of Hamilton-Wentworth, the solid waste disposal facilities for each municipality became the responsibility of the Region. Proctor and Redfern Limited was engaged to extend the initial study and recommend an overall solid waste management system for the period 1975-1995. The terms of reference for the revised study are shown in Appendix 'B'.

As work proceeded on the study, several interim reports and technical documents were produced. These reports are shown as Items (ii) - (viii) of the selected bibliography.

Following the preparation of the last report of the Consultant, a process of public participation took place. This Final Report incorporates adjustments to the previous recommendations partially as a result of the public input. It also attempts to respond to written material received from individuals and groups relative to the proposed solid waste management system for the Region.

3. SUMMARY OF RECOMMENDATIONS

1. That the Recommended System, System 1 as described in Section 4.4 and 4.8 and consisting of a 2,000 tons per day baler and the SWARU in East Hamilton, a 1,000 tons per day baler at Upper Ottawa Street, a 250 tons per day loose transfer station in Dundas, and a balefill site in Glanbrook be adopted as the system of Solid Waste Management for the Region for the period 1977 - 1986 inclusive.

2. That the Region proceed immediately to acquire the Glanbrook Balefill Site as shown on Drawing No. 2.

3. That the Region either acquire the area shown as Alternative 1 on Drawing No. 3 for the proposed baler and (ultimate) materials recovery facility from the City of Hamilton, or alternatively acquire the larger site on the west side of Kenora Avenue shown as Alternative 2 on Drawing No. 3. Prior to proceeding with land acquisition for either of these sites a functional design of the ultimate baler-materials recovery facility should be carried out to ensure that the proposed site will have an adequate area.

4. That the Region set aside 20 acres at the existing Upper Ottawa Street Landfill Site for the proposed baler and (ultimate) materials recovery facility.

5. That the Region provide sufficient space for the proposed Dundas Transfer Station at the existing Dundas Landfill Site.

6. That the Region make the necessary applications to the Province for permission to install baler-transfer stations at the East Hamilton Site and the Upper Ottawa Street Site, to establish a transfer station in Dundas and a balefill site in Glanbrook.

7. That a decision be made as to whether or not the entire solid waste management system or a part or parts of it shall be owned and/or operated by private enterprise.

8. That following preliminary Provincial approval of the scheme, either engineering designs be carried out for the baler stations, transfer station and balefill site, or, depending on the decisions on recommendation No. 7 that proposals be invited from private enterprise for the provision of the appropriate part or parts of the proposed system.

9. That a copy of Section 7 of this report be forwarded to all individuals and groups who forwarded written briefs to the Region.

10. That the net cost of operating the system be charged to area municipalities as a part of the general Regional tax levy.

11. That a commercial/industrial user charge be established on the basis of the concepts outlined in Section 4.14(ii) of this report.

12. That the Region agree in principle to the concept of adding 'front end' materials recovery systems to the proposed system when such systems are technically and financially feasible, and within the framework of the Ministry of the Environment's timetable as shown in Section 6.2 of this report, and that a study be carried out to establish the technical and financial feasibility of a 'front end' materials recovery system following implementation of the recommended system of solid waste management.

13. That the Region agree to and make known the recommendations for the disposal of non-acceptable wastes as described in Section 4.12 of this report.

14. That a detailed hydrogeological investigation of the proposed Glanbrook balefill site be carried out and that a report be prepared recommending what measures are necessary to use the site for balefill in accordance with Provincial requirements.

15. That all area municipalities be encouraged to institute a complete urban and rural residential solid waste collection system.

16. That the Region pass a by-law that defines 'Acceptable Wastes' and requires that only 'Acceptable Wastes' be accepted by the Region from Municipal and Private sources.

17. That where possible each area municipality continue to use existing disposal facilities until such time as the appropriate new facility is available.

18. That the Region endorse the concept of the proposed Glanbrook Balefill Site being developed as a wood lot or for agricultural purposes following completion of the balefill operation.

19. That following acquisition of the Glanbrook site, the Region lease the sections of it that will not be needed for some time for agricultural purposes.

20. That, following the abandonment of existing Regional Disposal Sites they be rehabilitated using non-acceptable wastes, subject to the preparation of proper operational and end-use plans.

4. THE RECOMMENDED SYSTEM

4.1 General

The recommended solid waste management system is shown in Drawing No. 1. It consists of the following components:

i). A 537 acre (250 acres useable) balefill site in the Township of Glanbrook (Drawing No. 2).

ii). A 2,000 ton per day baler-transfer station located adjacent to the existing East Hamilton Solid Waste Reduction Unit (Drawing No. 3)

iii). A 1,000 ton per day baler-transfer station located at the existing Upper Ottawa Street Landfill Site (Landfill operation to cease and site to be rehabilitated).

iv). A 250 ton per day transfer station at the existing landfill site in Dundas.

v). An existing 600 tons per day incinerator combined with a front end materials recovery system (SWARU).

4.2 Definitions

a). Acceptable Wastes

The system is designed to manage 'acceptable' waste. Acceptable waste may further be subdivided into the following categories:

Residential:

That waste that is picked up from residences by vehicles owned by each of the local municipalities, or by a private contractor under the terms of a contract with a local municipality. That material delivered to the disposal site by small private vehicles.

Non-Residential:

That waste that is picked up from apartment buildings, restaurants, offices, shopping plazas, etc. by private contractors.

Municipal:

Street sweepings, tree clippings, etc. picked up in association with municipal maintenance.

Industrial:

Waste generated by industry and picked up by private contractors or transported by industry itself.

b). Non-Acceptable Wastes

It is proposed that 'non-acceptable wastes' be disposed of in the quarries shown in Drawing No. 1.

Non-acceptable waste may be defined as follows:

i). Construction debris

ii). Earth fill beyond the minimum requirements of the Region's needs for earth cover.

iii). Broken concrete, asphalt and other inert materials.

In order that the system may function as proposed, it is recommended that the Region pass a by-law that defines the term 'Acceptable Wastes' and requires that only Acceptable Wastes be accepted by the Region from Municipal and Private sources.

4.3 Previous Schemes

The recommended scheme differs from that of our sixth interim report in the following respect:

i). The new Ancaster Landfill Site is deleted.

ii). A small transfer station is added in Dundas.

iii). A baler transfer station in the existing Upper Ottawa landfill site is added.

These changes mean that the recommended scheme now constitutes a system that is more integrated (all waste is either baled or disposed of at SWARU), and easier to manage (only one disposal site) while maintaining a high level of service.

4.4 Details of Recommended System for Acceptable Wastes

Table 'A' shows the use of the recommended system for acceptable wastes, it should be reviewed in conjunction with Drawing No. 1. The recommended capacity of each of the facilities is shown in Table 'B'.

The system may briefly be described as follows:

i). All acceptable wastes from Flamborough and Dundas will be delivered to the proposed 250-tons per day transfer

TABLE A

USE OF THE RECOMMENDED SYSTEM FOR ACCEPTABLE WASTES

Location of Facility	Type of Facility	Areas Served	Type of Waste	Destination of Transferred Wastes
Dundas Existing Sanitary Landfill Site	Transfer station	Flamborough, Dundas	All acceptable wastes	East Hamilton Baler
Hamilton Upper Ottawa Street	Baler-Transfer Station	Ancaster, Glanbrook, Stoney Creek (above escarpment) Hamilton (above escarpment)	All acceptable wastes	Glanbrook Balefill site
Hamilton Kenora Avenue (Adjacent SWARU)	Baler-Transfer Station	Hamilton (below escarpment) Stoney Creek (below escarpment) and Dundas Transfer Station	Non-combustible components of acceptable wastes and combustibles beyond capacity of SWARU	Glanbrook Balefill site
Hamilton, Kenora Avenue	SWARU	Hamilton (below escarpment) Stoney Creek (below escarpment)	Combustible components of acceptable wastes up to capacity of Plant	

NOTE: Private vehicles with small loads to use Dundas Transfer Station or Upper Ottawa Street Baler only.

station at Dundas. The wastes will then be transferred to the baler-transfer station at the East Hamilton site. This material must be baled as it will consist of a mixture of residential and other types of acceptable wastes, and is not as suitable for disposal at SWARU as is homogenous residential wastes or other combustibles such as paper wastes. Following baling, the wastes will be placed on flat-bed trailers, transported to the Glanbrook site, and placed in the balefill.

ii). All acceptable wastes from Ancaster, Glanbrook and those sections of Stoney Creek and Hamilton above the escarpment will be delivered to the baler-transfer station at Upper Ottawa Street. The material will then be baled, placed on flat-bed trailers, transported to the Glanbrook site, and placed in the balefill.

Private vehicles with small loads of acceptable wastes originating from those sections of Hamilton and Stoney Creek below the escarpment will also unload at the Upper Ottawa Street baler-transfer station and these wastes will also be disposed of as shown above.

iii). All acceptable wastes from those sections of Hamilton and Stoney Creek below the escarpment with the exception of loads in small private vehicles, will be delivered to the East Hamilton Baler-Transfer Station/Solid Waste Reduction Unit. Loads of combustible wastes up to the capacity of SWARU will be directed to it, the balance will be directed to the baler-transfer station, where the material will be baled, transferred to flat-bed trailers, transferred to the Glanbrook site and placed in the balefill.

4.5 Amounts of Wastes to be Managed

Table 'C' shows the estimated tonnages of the various categories of acceptable wastes to be hauled to each of the facilities from each of the areas of solid waste generation for the years 1977 and 1985. Table 'D' shows the total estimated tonnages to be handled at each facility for the same two years.

The proposed capacity of the East Hamilton Baler-Transfer Station will be exceeded about half way through the design period (i.e. approximately 1981). At this time, however, spare capacity will still be available at the Upper Ottawa Street Baler. If wastes can be diverted from below the escarpment to Upper Ottawa Street, a double shift at both baler facilities would be sufficient to handle

TABLE C

ESTIMATED TONNAGES OF ACCEPTABLE WASTES HAULED DIRECT TO FACILITIES

Location of Facility	Area Served	TONNAGE OF WASTE BY TYPE IN TONS/YEAR									
		1977					1985				
		Residential	Non-Residential	Municipal	Industrial	Total	Residential	Non-Residential	Municipal	Industrial	Total
Dundas Transfer Station	Dundas	7,100	7,800	1,400	5,900	22,200	11,700	10,400	2,000	8,400	32,500
	Flamborough	9,500	4,800	1,900	7,900	24,100	14,000	7,200	2,400	10,000	33,600
Upper Ottawa St Baler	Ancaster	7,000	2,500	1,400	5,800	16,700	11,600	3,300	2,000	8,300	25,200
	Glanbrook	4,200	2,400	800	3,500	10,900	6,000	3,700	1,000	4,300	15,000
	Hamilton (above escarpment)	45,100	40,700	8,800	9,700	104,300	70,700	70,800	11,900	13,000	166,400
	Stoney Creek (above escarpment)	3,200	1,600	600	1,100	6,500	6,300	3,500	1,000	1,900	12,700
East Hamilton Baler	Hamilton (below escarpment)	--	245,700	--	85,000	330,700	--	468,200	--	102,300	570,500
	Stoney Creek (below escarpment)	--	9,300	--	9,500	18,800	--	17,300	--	11,000	28,300
SWARU	Hamilton (below escarpment)	68,500	112,500**	13,400*	--	194,400	90,800	87,400**	15,200*	--	193,400
	Stoney Creek (below escarpment)	9,500	4,200**	1,900*	--	15,600	11,800	2,800**	2,000*	--	16,600
						744,200					1,094,200

* Part of these wastes may go to East Hamilton Baler if not suitable for SWARU.
** These tonnages will increase if conbumstables from*above are less than anticipated.

TABLE D

ESTIMATED TONNAGES OF ACCEPTABLE WASTES
BY TYPE TO BE HANDLED AT EACH FACILITY

Location of Facility	WASTE BY TYPE IN TONS/YEAR											
	1977						1985					
	DIRECT				Transfer from Dundas	Total	DIRECT				Transfer from Dundas	Total
	Residential	Non-Residential	Municipal	Industrial			Residential	Non-Residential	Municipal	Industrial		
Dundas Transfer Station	16,600	2 600	3,300	13,800	--	46,300	25,700	17,700	4,200	18,400	--	66,100
Upper Ottawa St Baler	59,500	47,200	11,500	20,100	--	138,400	94,600	81,300	15,900	27,600	--	219,300
East Hamilton Baler	--	255,000**	--	94,500	46,300	395,800	--	485,500**	--	113,300	66,100	664,900
SWARU	78,000	116,700	15,300*	--	--	210,000	102,600	90,200	17,200*	--	--	210,000

* Part of these wastes may go to East Hamilton Baler if not suitable for SWARU.

** Part of these wastes may go to SWARU if * is less than shown.

the 1985 load. Alternatively, the East Hamilton Baler could be run for longer periods and the Upper Ottawa Street facility could be operated for a period less than a double shift.

Tnere is sufficient capacity at the East Hamilton Baler that if for any reason SWARU becomes temporarily inoperative, all wastes can be handled by the baler with a continuous operation.

4.6 Traffic Generation

The estimated number of vehicles of each type using each facility for the years 1977 and 1985 is shown in Table E . Table F shows the estimated number of vehicle trips per day for each working day for each facility for the same years. A significant traffic load (almost 1,500 trips per day for 1985) will be generated by the SWARU/ baler facility, the other facilities, however, will generate a relatively light load.

Although the SWARU traffic load is high, in our opinion it can be accommodated given suitable geometrics and signalisation in the area. The details of the required work will be determined during our parallel traffic study which is now underway.

4.7 Required Acreage Glanbrook Balefill Site

Table G shows the estimated cumulative generation of wastes throughout the Region for the period 1976 - 1996. The curve shows that the total wastes generated in the period 1976 - 1991 will be equal to the capacity of the proposed Glanbrook Balefill Site assuming a bale depth of 40 feet. As is detailed elsewhere

in this report, it is anticipated that the Region will institute a large-scale materials recovery project or an innovative solid waste management method during the lifetime of the balefill site. As a result of either of these possibilities, the amount of wastes to be balefilled will reduce significantly, and hence the lifetime of the disposal site can be expected to extend well beyond 1991.

Table G indicates a 250 acre site. Although the total area of the recommended balefill site is approximately 537 acres, only approximately 250 acres are useable for balefill purposes.

TABLE E

ESTIMATED NUMBER OF VEHICLES PER DAY USING FACILITIES

FACILITY	1977 TRAFFIC IN						1977 TRAFFIC OUT (Weight)	1985 TRAFFIC IN						1985 TRAFFIC OUT (Weight)
	MUNICIPAL		INDUSTRIAL		REGIONAL	TOTAL IN		MUNICIPAL		INDUSTRIAL		REGIONAL	TOTAL IN	
	Residential 5.0T.	Municipal Responsibility 5.0T.	Non-Residential 4.8 T.	Industrial Responsibility 6.1 T.	Transfer 18.8 T.			Residential 5.0 T.	Municipal Responsibility 5.0 T.	Non-Residential 4.8 T.	Industrial Responsibility 6.1 T.	Transfer 18.8 T.		
Dundas Transfer Station	13	3	10	9	--	35*	9 (18.8 T)	20	3	14	12	--	49*	14 (18.8 T
Upper Ottawa St Baler	46	9	38	13	--	106*	18 (30.0 T)	73	12	65	17	--	167*	28 (30.0 T
East Hamilton Baler	--	--	204	60	9	273	51 (30.0 T)	--	--	389	71	14	474	85 (30.0 T
SWARU***	60	12**	94	--	--	166	--	79	13**	72	--	--	164	--
Glanbrook Site						69	--						113	--

* These totals do not include small private vehicles

** Some of these vehicles may go to the East Hamilton Baler

*** Number of vehicles into SWARU calculated on 5-day week, 260 days per year.

TABLE F

ESTIMATED NUMBER OF VEHICLE TRIPS PER WORKING DAY FOR EACH FACILITY

Facility	1977		1985	
Dundas Transfer Station	88		126	
Upper Ottawa Street Baler	248		390	
East Hamilton Baler	648	980	1118	1446
SWARU	332		328	
Glanbrook Site	138		226	

NOTE: i). Totals do not include small private vehicles at Upper Ottawa Street and Dundas facilities.

ii). One in and out movement = 2 vehicle trips.

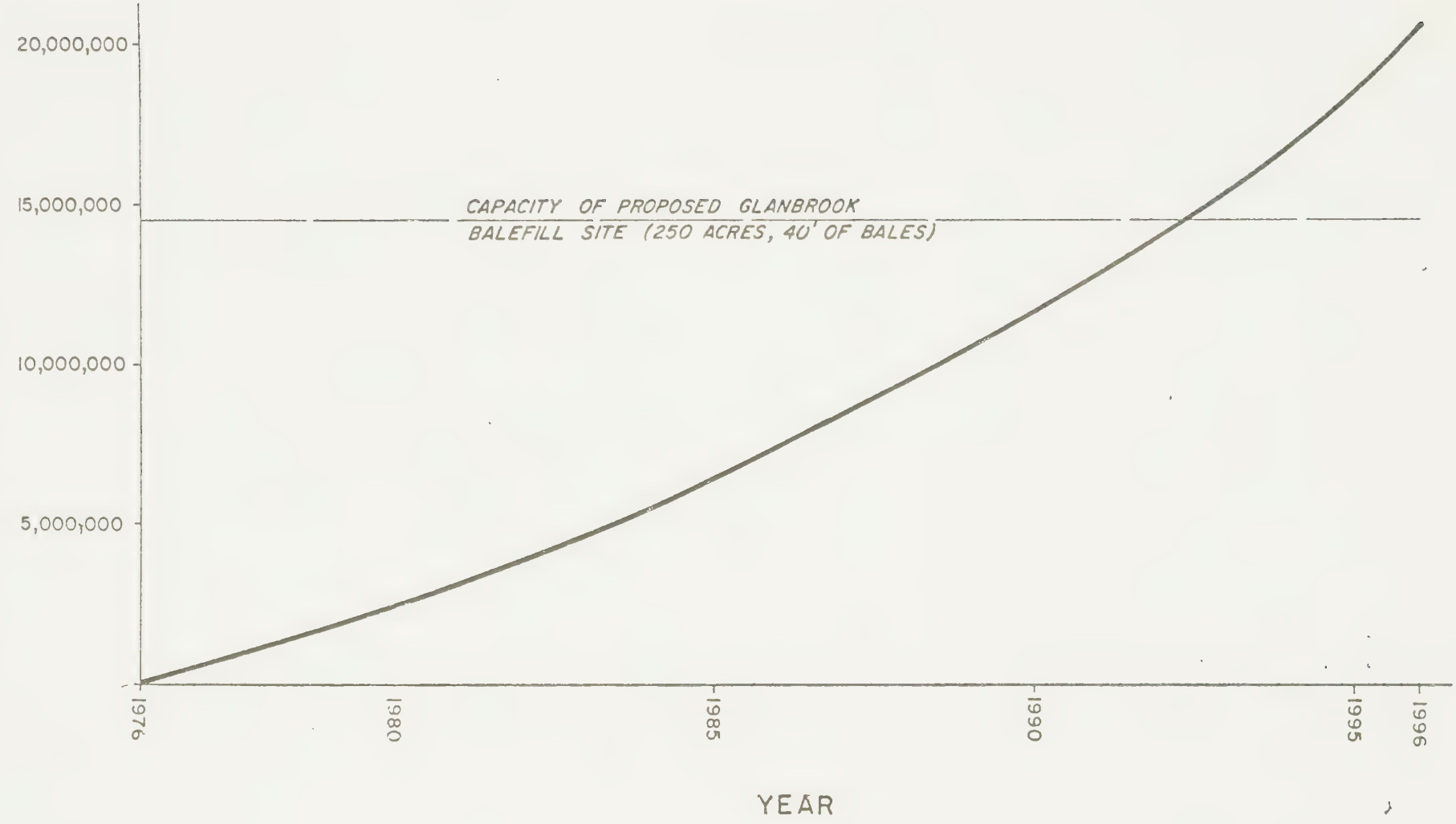

TABLE G

ESTIMATED CUMULATIVE GENERATION OF ACCEPTABLE WASTES 1976-1996

4.8 Alternatives to the Recommended System

We have estimated the capital and operating costs of the recommended system and six alternatives. These systems are defined as follows:

System 1:

This is the recommended system.

System 2:

This is the same as recommended system, except that the Dundas transfer station is replaced by a 1,000 tons per day baler and all acceptable wastes from Dundas, Flamborough, Ancaster and West Hamilton are directed to this facility. This system was postulated since it would eliminate the double handling associated with the Dundas Transfer Station. The baler would probably be located in the extreme west end of Hamilton and bales would be trucked directly to Glanbrook. It was found, however, that the savings due to eliminating double handling would be more than offset by increased haul time and increased capital costs. The most practical route for the bale trucks to Glanbrook from the West Hamilton baler would probably be via Highway No. 20, and hence they would pass close to the SWARU/baler facility.

Systems 3A, 3B:

These systems consist of a single 3,000 tons per day baler at either the SWARU (System 3A) or Upper Ottawa Street (System 3B) site. This sytem has a lower operating cost than either System 1 and System 2, however, it has the following disadvantages:

i). Municipal haul costs from some areas would be extremely high.

ii). Traffic problems would be created by the high number of vehicle trips per day at the facility which are estimated as follows:

1977:	896	If facility at Upper Ottawa Street (System 3B)
1985:	1508	
1977:	1228	If facility at East Hamilton, including SWARU traffic (System 3A)
1985:	1836	

The traffic load would probably be acceptable at the East Hamilton Site, but unacceptable at the Upper Ottawa Street Site. The Upper Ottawa Street site is more desirable from the point of view of municipal haul from the rural areas of the Region.

iii). Large numbers of industrial collection vehicles ascending the escarpment and returning empty for System 3B.

Large numbers of municipal collection vehicles descending the escarpment and returning empty for System 3A.

Systems 4A, 4B:

These systems are similar to systems 3A and 3B. System 4A is the same as System 3A, except that a 250 tons per day transfer station is added at Dundas. System 4B is the same as System 3B except that a 250 tons per day transfer station is added at Dundas. The Dundas Transfer Station would serve the same areas and operate in the same manner as in System 1.

The high municipal haul costs for Dundas and Flamborough are reduced in these systems compared with Systems 3A and 3B. However, there is relatively little effect on the heavy escarpment traffic that would be generated.

System 5:

This is the same as system 1, with the exception that the Dundas transfer station is eliminated.

The escarpment traffic is largely eliminated with this system. However, municipal collection vehicles from Dundas and Flamborough would have a long haul to the baler - an average of one hour and twenty minutes compared to an average of twenty minutes to the existing local landfill sites.

The estimated throughputs for each facility in each system are shown in Table H.

TABLE H

1977 Throughput for Various Systems

Tons per Day (1985 Throughputs shown in Brackets)

	System 1	System 2	System 3A	System 3B	System 4A	System 4B	System 5
East Hamilton Baler	1520 (2560)	1000 (1700)	2050 (3400)		2050 (3400)		1520 (2560)
Upper Ottawa Street Baler	530 (840)	530 (840)		2050 (3400)		2050 (3400)	530 (840)
SWARU	600 (600)	600 (600)	600 (600)	600 (600)	600 (600)	600 (600)	600 (600)
Dundas Transfer Station	180 (250)				180 (250)	180 (250)	
West Hamilton Baler		520 (860)					

4.9 Capital Costs

The estimated capital costs for the various components from which the alternative systems can be assembled are as follows:

Single Baler -Transfer Facility Design Capacity 3,000 tons per day:

Land
Building - roads, landscaping, etc.
3 - 60 second balers
Weigh scales
Electrical including 3,500 KVA substation
3 - Front end loaders
3 - Fork lift tractors
Engineering

TOTAL $ 5,800,000.

Single Baler - Transfer Facility Design Capacity 2,000 tons per day:

Land
Building - roads, landscaping, etc.
2 - 60 second balers
Weigh scales
Electrical including 2,500 KVA substation
2 - Front End loaders
2 - Fork lift tractors
Engineering

TOTAL $ 4,600,000.

Single Baler - Transfer Facility Design capacity 1,000 tons per day:

Land
Building - landscaping, etc.
1 - 60 second baler
Weigh scales
Electrical including 2,000 KVA substation
1 - Front end loader
1 - Fork lift tractor
Engineering

TOTAL $ 3,000,000.

Dundas Transfer Station

Land
Building - 5,000 sq.ft. - roads, landscaping, etc.
1 - Compactor
Weigh scales
1 - Front End Loader
Engineering

TOTAL $ 350,000.

Transfer Equipment

(requirements for 1977 Thruput, as shown on Table I)

System 1:

Bale Transfer Equipment:

13 - Tractors	at $39,000	$ 507.000
35 - Trailers	at $11,500	402,500

Loose Transfer Equipment:

2 - Tractors	at $39,000	$ 78,000
3 - Trailers	at $32,000	96,000
	TOTAL	$1,083,500.

System 2:

Bale Transfer Equipment:

15 - Tractors	at $39,000	$ 585,000
34 - Trailers	at $11,500	391,000
	TOTAL	$ 976,000.

Systems 3A, 3B:

Bale Transfer Equipment:

12 - Tractors	at $39,000	$ 468,000
28 - Trailers	at $11,500	322,000
	TOTAL	$ 790,000

Systems 4A, 4B:

Bale Transfer Equipment:

12 - Tractors	at $39,000	$ 468,000
28 - Trailers	at $11,500	322,000

Loose Transfer Equipment:

2 - Tractors	at $39,000	$ 78,000
3 - Trailers	at $32,000	96,000
	TOTAL	$ 964,000.

System 5:

Bale Transfer Equipment:

13 - Tractors	at $39,000	$ 507,000
35 - Trailers	at $11,500	402,500
	TOTAL	$ 909,500.

TABLE I

TRANSFER EQUIPMENT REQUIRED FOR
VARIOUS SYSTEMS, 1977 THROUGHPUT

Location	System 1	System 2	System 3A	System 3B	System 4A	System 4B	System 5
East Hamilton Baler	9 tractors 29 trailers	7 tractors 22 trailers	12 tractors 28 trailers		12 tractors 28 trailers		9 tractors 29 trailers
Upper Ottawa Street Baler	4 tractors 6 trailers	4 tractors 6 trailers		12 tractors 28 trailers		12 tractors 28 trailers	4 tractors 6 trailers
SWARU							
Dundas Transfer Station	2 tractors 3 trailers				2 tractors 3 trailers	2 tractors 3 trailers	
West Hamilton Baler		4 tractors 6 trailers					

Glanbrook Balefill Site

2 - 4 cu.yd. front end loaders	at $100,000	
1 - Tandem Dump Truck	at $ 45,000.	
Land		
Fences, site building, access roads, landscaping		
Engineering		
	TOTAL	$1,945,000.

Estimated Capital Cost for System 1:

2,000 tons per day baler	$ 4,600,000.	
1,000 tons per day baler	3,000,000.	
Dundas Transfer Station	350,000.	
Transfer equipment	1,083,500.	
Glanbrook Balefill Site	1,945,000.	
	TOTAL	$10,978,500.

Estimated Capital Cost for System 2:

2,000 tons per day baler	$ 4,600,000.	
1,000 tons per day baler	3,000,000.	
1,000 tons per day baler	3,000,000.	
Bale Transfer equipment	976,000.	
Glanbrook Balefill Site	1,945,000	
	TOTAL	$13,521,000.

Estimated Capital Cost for System 3A or 3B:

3,000 tons per day baler	$ 5,800,000.	
Bale Transfer equipment	790,000.	
Glanbrook Site	1,945,000.	
	TOTAL	$ 8,535,000.

Estimated Capital Cost for System 4A or 4B:

3,000 tons per day baler	$ 5,800,000.	
Dundas Transfer Station	350,000.	
Transfer Equipment	964,000.	
Glanbrook Site	1,945,000.	
	TOTAL	$ 9,059,000.

Estimated Capital Cost for System 5:

2,000 tons per day baler	$ 4,600,000.	
1,000 tons per day baler	3,000,000.	
Bale Transfer Equipment	909,500.	
Glanbrook Balefill Site	1,945,000.	
	TOTAL	$10,454,500.

4.10 Operating Costs

i). Non-Regional Operating Costs

In order to assess the true cost of the system we have indicated part of the operating costs to municipalities and private haulers in our analysis of each of the systems as well as the cost to the Region. The part of the municipal/industrial cost included is the cost of haul from the collection area for each of the schemes. The hourly rates used in calculating these costs include vehicle maintenance, depreciation and operation expenses including salaries and overhead. In some cases additions to collection fleets may be required, and the total cost of these additions is refelcted in the per-ton costs. The per-ton haul cost for each type of waste to each facility from each collection area is shown in Table 'J'.

ii). Regional Costs

The components of Regional Operating Cost from which the system operating costs can be assembled are as follows (based on 10 percent amortization, with the exception of SWARU):

[illegible] Capital Costs

	Capital Cost	Par- ticip.	Annual Cost
3,000 tons per day baler	$5,200,000	1	[illegible]
2,000 tons per day baler	4,000,000	1	740,000
1,000 tons per day baler	2,200,000	1	406,000
150 tons per day transfer station	350,000	1	57,000
Glenrock Sanitill Site	1,945,000	1	316,000
System 1			
Transfer Fleet	1,333,500	5	335,700
System 2			
Transfer Fleet	572,000	5	137,400
System 3A, 3B			
Transfer Fleet	732,000	5	188,300
System 4A, 4B			
Transfer Fleet	984,000	5	254,200
System 5			
Transfer Fleet	810,500	5	208,500
Swaco			
Existing 11-Year Debentures			586,000

Estimated Annual Operational Costs for [illegible]

3,000 tons per day baler including wages, insurance, taxes, maintenance, hydro, etc.	$1,780,000
2,000 tons per day baler	[illegible]
1,000 tons per day baler	[illegible]
150 tons per day transfer station	110,000
Glenrock landfill site including bale installation, mass earth excavation, engineering (first year only)	[illegible]
Bale truck operation for all but System 1 504,200 tons at $1.50	$756,300
Loose transfer truck operation 46,300 tons at $4.00	185,200
Swaco	1,276,400
Bale truck operation for System 1 434,100 tons at $1.60 100,000 tons at $3.50	1,044,760

TABLE I

PER TON HAUL COSTS FROM COLLECTION AREA TO FACILITY

Collection Area	Dundas Transfer Station and West Hamilton Baler				Upper Ottawa Street Baler				East Hamilton Baler or SWARU				Existing Disposal Site/SWARU			
	Residential	Municipal	Non-Residential	Industrial	Residential	Municipal	Non-Residential	Industrial	Residential	Municipal	Non Residential	Industrial	Residential	Municipal	Non-Residential	Industrial
Dundas	1.68	1.20	1.26	0.60	6.16	4.40	4.62	2.20	7.84	5.60	5.88	2.80	1.68	1.20	1.26	0.60
Flamborough	3.36	2.40	2.52	1.20	7.28	5.20	5.46	2.60	6.16	4.40	4.62	2.20	2.24	1.60	1.68	0.80
Ancaster	2.80**	2.00**	2.10**	1.00**	5.04	3.60	3.78	1.80	8.96	6.40	6.72	3.20	1.68	1.20	1.26	0.60
Glanbrook					2.80	2.00	2.10	1.00	3.92	2.80	2.94	1.40	2.24	1.60	1.68	0.80
Stoney Creek Above escarpment					2.80	2.00	2.10	1.00	2.80	2.00	2.10	1.00	1.68	1.20	1.26	0.60
Stoney Creek below escarpment					3.92	2.80	2.94	1.40	2.80	2.00	2.10	1.00	1.68	1.20	1.26	0.60
Hamilton above escarpment					2.24	1.60	1.68	0.80	6.72	4.80	5.04	2.40	6.72* 2.24	1.60	1.68	0.80
Hamilton below escarpment	2.80**	2.00**	2.10**	1.00**	3.92	2.80	2.94	1.40	2.80	2.00	2.10	1.00	2.80* 3.92	2.80	2.94	1.40

Residential wastes at $28.00 per vehicle hour
Municipal wastes at $20.00 per vehicle hour
Non-residential wastes at $20.00 per vehicle hour
Industrial wastes at $12.00 per vehicle hour.

* Cost for haul to SWARU.

** Costs only apply for haul to West Hamilton Baler.

The Annual Operating Cost to the Region for 1977 for each of the Systems may then be calculated as follows:

System 1: Recommended Scheme

2,000 tons baler debentures	$ 748,600.
2,000 tons baler operating cost	1,300,000.
1,000 tons baler debentures	488,200.
1,000 tons baler operating cost	650,000.
250 tons transfer station debentures	57,000.
250 tons transfer station operating cost	110,000.
Transfer Fleet debentures	285,700.
Transfer Fleet operating cost	854,700.
Loose Transfer Fleet operating cost	185,200.
SWARU debentures	898,600.
SWARU operating cost	1,276,400.
Glanbrook balefill site debentures	316,600.
Glanbrook balefill site operating cost	1,015,000.
TOTAL	$8,186,000.

Total Regional Cost per ton: 744,200 tons at $11.00

System 2: Three Balers

2,000 tons baler debentures	$ 748,600.
2,000 tons baler operating cost	1,300,000.
2 x 1000 tons balers debentures	976,400.
2 x 1000 tons balers operating cost	1,300,000.
Transfer Fleet debentures	257,400.
Transfer Fleet operating cost	1,044,700.
Glanbrook balefill site debentures	316,600.
Glanbrook balefill site operating cost	1,015,000.
SWARU debentures	898,600.
SWARU operating cost	1,276,400.
TOTAL	$9,133,700.

Total Regional cost per ton: 744,200 tons at $12.27

System 3A or 3B; Single Baler

3,000 tons baler debentures	$ 943,900.
3,000 tons baler operating cost	1,750,000.
Transfer Fleet debentures	208,300.
Transfer Fleet operating cost	854,700.
Glanbrook balefill site debentures	316,600.
Glanbrook balefill site operating cost	1,015,000.
SWARU debentures	898,600.
SWARU operating cost	1,276,400.
TOTAL	$7,263,500.

Total Regional cost per ton: 744,200 tons at $9.76.

System 4A or 4B: Single Baler with Transfer Station

3,000 tons baler debentures	$ 943,900.
3,000 tons baler operating cost	1,750,000.
250 tons transfer station debentures	57,000.
250 tons transfer station operating cost	110,000.
Transfer Fleet debentures	254,200.
Loose transfer fleet operating cost	185,200.
Bale transfer fleet operating cost	854,700.
Glanbrook balefill site debentures	316,600.
Glanbrook balefill site operating cost	1,015,000.
SWARU debentures	898,600.
SWARU operating cost	1,276,400.
TOTAL	$7,661,600.

Total Regional cost per ton: 744,200 tons at $10.29

System 5: Two Balers

2,000 tons baler debentures	$ 748,600.
2,000 tons baler operating cost	1,300,000.
1,000 tons baler debentures	488,200.
1,000 tons baler operating cost	650,000.
Transfer Fleet debentures	239,800.
Transfer fleet operating cost	854,700.
Glanbrook balefill site debentures	316,600.
Glanbrook balefill site operating cost	1,015,000.
SWARU debentures	898,600.
SWARU operating cost	1,276,400.
TOTAL	$7,787,900.

Total Regional cost per ton: 744,200 tons at $10.46

Summary: Regional Operating Cost per Ton (1977 - Estimated)

System 1:	$11.00
System 2	$12.27
System 3A, 3B	$ 9.76
System 4A, 4B	$10.29
System 5	$10.46

Clearly Systems 3A and 3B are the most economical in terms of cost to the Region. However, the Regional costs must be compared with the local costs to determine the real total cost per ton for the system, otherwise an incongruous recommendation would be developed (for example, a system of even lower cost to the Region would be to locate the balers at the Glanbrook Site. However, this would result in unreasonably long hauls for collection vehicles).

4.11 Total Costs

Table K shows the composite municipal and private per ton haul costs for each scheme and for each area municipality. These figures have been developed from the unit haul costs in Table J . Table K also shows the weighted average or composite local haul cost from the collection area to the disposal facility for the entire Region for each of the schemes. This cost is then added to the Regional disposal cost to arrive at the estimated total average combined local and Regional disposal cost for the waste. The costs in Tables J and K are based on the assumption that all area municipalities have complete municipal collection systems.

Inspection of Table K indicates that with the exception of System 2 there is little difference in total per ton cost of disposal. System 2 is the most expensive since it provides 4,000 tons per day baling capacity versus 3,000 tons per day for the other schemes. However, this difference is largely excess capacity even at the end of the design period, therefore in our opinion, System 2 should be discarded due to high costs. System 1, the recommended system, has the second highest per ton cost of all the systems, although the difference in cost between it and the lower cost schemes is relatively small, and within the margin of error of the figures used in our analysis. The operational advantages and disadvantages of the various systems are shown in Section 4.8, while these point to System 1 as the best scheme, further inspection of Table K confirms this. Only Systems 2 and 4B have comparable evenness of local haul costs. System 2 has already been rejected due to high cost and System 4B results in undesirable traffic loads in the Upper Ottawa Street area.

TABLE K

COMPOSITE COST OF MUNICIPAL AND PRIVATE
HAUL FROM COLLECTION AREAS TO
DISPOSAL FACILITY AND TOTAL DISPOSAL COSTS

RECOMMENDED AND ALTERNATIVE SYSTEMS

Area Municipality	1977 Annual Tonnage All Types	HAUL COST PER TON						
		System 1	System 2	System 3A	System 3B	System 4A	System 4B	System 5
Dundas	22,200	1.22	1.22#	5.67	4.46	1.22	1.22	4.46**
Flamborough	24,100	2.41	2.41#	4.42	5.22	2.41	2.41	4.42***
Ancaster	16,700	3.61	2.00#	6.40*	3.61	6.40*	3.61	3.61
Glanbrook	10,900	2.01	2.01	2.81*	2.01	2.81*	2.01	2.01
Stoney Creek	40.900	1.97*	1.97*	1.97*	2.31*	1.97*	2.31*	1.97*
Hamilton	629,400	1.98*	1.98*+	2.59*	2.79*	2.59*	2.79*	1.98*
Weighted average cost for all areas	744,200	2.01	1.97	2.80	2.90	2.60	2.71	2.17
Regional Disposal Cost per Ton		11.00	12.27	9.76	9.76	10.29	10.29	10.46
Combined Haul and Regional Diposal Cost per ton		13.01	14.24	12.56	12.66	12.89	13.00	12.63

* Part of these wastes go to SWARU
** To Ottawa Street Baler Facility
*** To East Hamilton Baler Facility & SWARU
\# To Dundas Baler Facility
\+ Part to Dundas Baler Facility.

Summary of Advantages of System 1

i). Collection traffic is split between three disposal points

ii). Bale transfer traffic split between two baler stations

iii). No area municipality faced with unusually high haul cost to disposal area.

iv). Reasonable total disposal cost for Region

4.12 Non-Acceptable Wastes

In Section 4.2 we have defined the terms 'Acceptable Wastes' and 'Non-Acceptable Wastes'. The recommended Regional Solid Waste Management System is designed to accept all acceptable wastes. However, large amounts of non-acceptable wastes will be generated within the Region during the design period. We have estimated these amounts as follows:

Year	Non-Acceptable Wastes (Tons)
1977	596,600
1978	612,900
1979	629,600
1980	646,900
1981	664,600
1982	682,800
1983	701,700
1984	720,900
1985	737,800
1986	762,000
TOTAL	6,755,800 tons

The above figures are of a more tentative nature than the estimates of acceptable waste generation, since the amount of non-acceptable waste generated is dependent on the amount of construction activity in the Region.

As indicated in Section 4.2 we recommend that non-acceptable wastes be disposed of in the construction debris disposal sites shown in Drawing No. 1. The sites shown in this drawing are the Cope Quarry in Stoney Creek, the abandoned quarry at Clappisons Corners, owned by S.J. Sheppard, and a site in Ancaster. The Ancaster site could be either the existing landfill site or old gravel pits owned by the Hamilton Region Conservation Authority.

The disposal of relatively inert non-acceptable wastes at these locations would constitute part of a rehabilitation programme for the sites. The Cope Quarry has capacity for approximately 2,200,000 tons, and further quarrying activity will make additional space available. The Clappisons Cut quarry has a capacity of approximately 600,000 tons and the volume that could be accepted at Ancaster would be a minimum of 200,000 tons.

The total capacity of these three facilities is therefore, in the order of 3,000,000 tons. While this amount is less than half that which is to be generated during the design period of the Study, we anticipate that some of this material will be disposed of at construction projects that require fill, and that therefore, the 3,000,000 tons capacity should be adequate until 1986 or thereabouts. Considerable additional capacity is also available in the other quarries in the Region, which are shown on Drawing No. 4. The owners of these quarries should also be encouraged to rehabilitate the sites by using non-acceptable wastes generated within the Region.

Rehabilitation of the Region's existing landfill sites will also create disposal possibilities for part of this material during the late 1970s.

Operation of Sites:

There is probably no advantage for the Region to become involved in the details of disposal of non-acceptable wastes, other than possibly passing a resolution endorsing the concept of disposing of these materials in

quarries for rehabilitation purposes. An inventory of properly run disposal sites should also be kept so that the Region can advise individuals of suitable locations where non-acceptable wastes may be deposited.

4.13 Adaptation by Addition of Front-End System

As is explained elsewhere in this report, a baler-transfer station is ideally suited for the addition of a front end materials reclamation system. There is ample space at the Upper Ottawa Street site for such an installation. At the East Hamilton Site immediately to the east of SWARU, space is extremely restricted and it is questionable whether or not a front end system consisting of primary and secondary shredding, ferrous metal separation and air classification could be incorporated with the proposed baler station. We therefore, recommend that the Region consider the alternative of acquiring a larger site, probably opposite SWARU, on the west side of Kenora Avenue. We would recommend that, prior to the acquisition of any site, a functional design of the proposed ultimate baler - recovery station be carried out. This would ensure that the parcel of land to be acquired would be adequate in size for the proposed use.

Since it would be necessary to purchase the site to the east of SWARU from the City of Hamilton, presumably at market value, the alternative of purchasing a site from a private owner should present no particular disadvantage from a financial point of view.

4.14 Charges for Use of System

The material in this section is intended to be general in nature and to provide background material for a discussion on charges.

i). Charges to Municipalities

The cost of operating the Regional system less any revenue will be borne by the taxpayers of the Region. The method of distributing this cost should be fair and equitable and should if possible, not require complex administrative procedures.

One way of charging municipalities would be to weigh all municipal loads delivered to Regional facilities and charge each municipality proportionally to the tonnage delivered to the Region by it. In our opinion this method should not be adopted for the following reasons:

a). A large number of weighing and billing operations will be necessary and a significant administrative cost will be incurred.

b). Weighing municipal loads does not reflect industrial/commercial waste generation. As indicated in 4.14(ii) a subsidy to the cost of disposal of industrial/commercial waste will probably be made. If charging is on the basis of municipal/residential loads no account will be taken of the industrial/commercial proportion of the waste. In other words, it may be construed that municipalities with a low proportion of industrial/commercial

assessment are 'subsidizing the subsidy' to industrial and commercial users of the system.

For the above reasons we recommend that the cost of operating the Regional Solid Waste Management system be included in the general operating costs of the Region and billed to the area municipalities as a part of the general Regional levy. In our opinion, this is administratively the simplest procedure and will result in municipalities with a relatively high proportion industrial/commercial assessment paying a higher proportion of the cost of operating the system. This is an equitable situation, since these municipalities generate more solid waste when it is measured on a per capita basis.

ii). Charges to Commercial Industrial Users

At present, the following charges are made at existing Regional disposal locations for Commercial and Industrial Wastes:

Passenger cars	No charge
Trucks, gross weight under 7000 lbs	$1.00
Single axle trucks over 7000 lbs.	$5.00
Single axle trucks over 20 cu.yards	$7.50
Double axle trucks less than 12 cu.yd.	$5.00
Double axle trucks normal load	$10.00
Double axle trucks over 20 cu.yards	$15.00
Single axle packer	$10.00
Double axle packer	$20.00

The above charges appear to represent a user charge of approximately $2.00 per ton.

As is indicated earlier in this section of the report, the estimated Regional cost for disposal of all wastes in 1977 is $11.00 per ton. It may be argued that Industry should be charged the full disposal cost. In our opinion this would be unreasonable, since industries are taxpayers and hence pay a part of the net cost of operating the system. A converse argument may also be made that no charge should be levied against industry since it pays taxes on the same basis as residential users of the system who are not charged directly for either collection or disposal. In our opinion this system would be undesirable, since there would be no financial incentive for commercial and industrial facilities to reduce or moderate their generation of solid waste.

It is therefore our recommendation that a per-ton disposal charge be established for commercial and industrial users. This charge should be between the existing charge of approximately $2.00 per ton and the actual Regional disposal cost of $10.84 per ton.

The estimated combined non-residential and industrial tonnages for the beginning and end of the study period are as follows:

1977	549,200 tons
1985	833,900 tons

The estimated revenue for each of these years may be calculated by multiplying the proposed disposal charge by the year's estimated tonnage.

5. BALING -

THE RECOMMENDED SOLID WASTE MANAGEMENT PROCEDURE

5.1 General

We recommend that the Region install balers with a capacity of 3,000 tons per 16-hour day. Our objective in this section of the report is to explain why we recommend this form of solid waste management.

5.2 Review of Alternatives

In our second interim report we briefly reviewed several innovative disposal techniques.

In 1972 we concluded that all of these processes are experimental in nature and require considerably more data before conclusions can be reached pertaining to their advantages and disadvantages as well as their economic viability. Although more information is available at this time, we cannot recommend that the Region commit itself of any of these systems. Apart from the consider-ation of unreliability, it is clear that all such systems have

a very high capital cost per ton of capacity. It would therefore, be unwise for the Region to commit any or all of its solid waste production to such a system at this time. These methods are discussed in more detail in Appendix 'C'.

Also in 1972 we reviewed briefly the following volume reduction methods of solid waste management:

i). compaction

ii). baling

iii). grinding

iv). shredding

There are several examples of each of the above systems in North America and elsewhere. Each of the systems 'preconditions' the waste material for ultimate disposal - usually in some form of landfill - although, in the SWARU, for example, incineration is the disposal method.

Our review of these possibilities therefore led us to a review of the following alternatives:

i). Conventional landfill

ii). Compaction/Baling

iii). Shredding/Grinding

Both alternatives (i) and (iii) require large, conventional push-pit transfer stations for transferring the solid waste to packer vehicles which transport it to the final landfill site, thus the real alternatives as far as the static equipment that is required are as follows:

(A) Transfer Station

(B) Compactor/Baler - transfer station

(C) Grinders/Shredders plus transfer station

The equipment costs for (A) and (B) are similar since there is relatively little difference between the capital cost of loose transfer equipment and compaction/baling equipment. For Alternative (C) the equipment cost almost doubles.

5.3 Advantages of Baling

The advantages of baling over the other systems may be summarized under the following headings:

1. Capital Cost

   A baler installation requires approximately the same capital investment as a conventional loose transfer station system, and approximately half the capital investment of a transfer plus shredding system.

2. Preconditioning:

The baler compacts the solid waste to such an extent that no compaction equipment is required at the balefill site. Compaction equipment is required at both conventional and shredded waste landfill sites.

The density of bales is significantly higher than that of shredded or raw waste after landfill compaction viz:

Compacted bales: 1,800 lbs. per cubic yard

Shredded waster after compaction: 1,200 lbs. per cubic yard

Conventional landfill after compaction: 800 lbs. per cu.yd.

The unit cost of land for balefill is therefore less than for other forms of landfill.

3. Reduction in Leachate Generation

Baled solid waste, stacked and covered, given equivalent conditions, generates less leachate than a conventional sanitary landfill or shredded waste landfill.

This is a statement that is rather difficult to quantify, however it is possible to cite the following factors:

i). The air and water content of the solid waste mix are reduced during the compaction part of the baling process, thereby limiting bacterial life and biochemical reaction.

ii). The high density of the bales results in a reduction in permeability and limits percolation, thereby reducing the amount of leachate released.

iii). The high density of the bales has an insulating effect which establishes a controlled cyclical form of biological activity.

iv). Since the balefill operation is easier to manage than other forms of landfill, it is a simpler matter to take measures which result in the control of leachate production, gas generation and infiltration.

4. Aesthetics

The balefill operation is the form of landfill least likely to generate aesthetic problems. The bales are relatively inert and will not attract birds and rodents. This is true to a lesser extent for shredded waste, but is not true for raw solid waste.

Installing the bales on the balefill site is a quieter and simpler procedure than other forms of landfill as no on-site compaction equipment is required.

5. Reduction in Traffic

Large packer vehicles (that transport loose transferred waste) are capable of carrying approximately 19 tons, whereas a flatbed bale truck is capable of carrying approximately 30 tons. Thus the number of bale truck trips required is 50 percent less than the number of packer truck trips for a given amount of solid waste.

5.4 Other Factors

There are certain other factors where a baling system is as good as if not better than a shredded or conventional landfill system.

1. Addition of Front End System

The cost of the addition of a front end system would be the same for systems (A) and (B) above. For system (C), it would probably be somewhat less.

For systems (A) and (B) Shredders, Air Classifiers and Ferrous Metal Separaters would be required. For system (C) the initial assumption would be that no

shredders would be required. This probably would not be the case, as we would envisage two stage shredding for a sophisticated front end system. The capital cost outlay for a front end system to system (C) would probably be about 25 percent less than for systems (A) and (B). For the latter systems, however, all the front end equipment would be new at the time of installing the recovery system.

From an overall point of view, in our opinion system (B) plus front end is the best system, as the residue would be baled rather than loose-landfilled.

2. Backup to SWARU

The design capacity of SWARU is 600 tons per day. It is our recommendation that the waste directed to it be the most suitable (i.e. that it be domestic waste plus combustible waste). It is likely that at certain times SWARU will not function and a backup system will be required. All of systems (A), (B) and (C) will provide backup if constructed to the capacity recommended in this report. System (B) - balefill, has the advantage that it produces the most inoffensive form of disposal material. This is a particularly useful characteristic when the percentage of domestic waste content rises, such as when SWARU is inoperative.

6. BALEFILL - THE INTERMEDIATE SOLUTION TO THE PROBLEM OF MANAGEMENT OF SOLID WASTE IN THE REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH

6.1 General

The major recommendation of this report is that the Region divert all solid waste that falls within its responsibility, and that cannot be disposed of by the existing SWARU, to a balefill site. The balefill concept, in our opinion, is a superior form of sanitary landfill. The reasons for recommending balefill are shown in Section 5 of this report.

6.2 Ministry Policy and Present Day Technology

During the process of public input considerable comment was received relating to the proposals contained in the Sixth Interim Report, generally of the following nature:

a). The recommendations do not take into account present day technological possibilities relating to materials and energy recovery.

b). The recommendations do not coincide with the policy of the Ministry of the Environment.

These are questions which relate to the fundamental concepts on which our recommendations are founded, and should be answered in a straightforward manner. It is our intention to respond to these questions in this section of the report.

Recent History

In the period 1970 - 1972 the City of Hamilton constructed the East Hamilton Solid Waste Reduction Unit. This facility was subsequently assumed by the Region upon the formation of the Regional Municipality of Hamilton-Wentworth.

The following processes occur in SWARU:

i). shredding

ii). ferrous metal separation

iii). incineration in a water wall furnace capable of generating steam for sale

iv). disposal of fly ash in an adjacent landfill site.

SWARU is an highly innovative solid waste management and disposal system. Operational problems have kept the actual capacity of the facility well below its design loading of 600 tons per day. Effectively SWARU is a full scale research and development model. Operational experience has contributed significantly to the advancement of the 'state of the art' of solid waste management.

In a speech in the Ontario Legislature on October 24th, 1974 the Honourable William Newman, Minister of the Environment announced a Provincial Programme which has the goal of establishing materials recovery systems throughout the province by 1990.

The main points of the programme may be summarized as follows:

1). The government will lead and support the establishment of a network of reclamation and waste processing plants, to be substantially complete by 1990.

2). To meet critical needs, six plants will be established in urban areas of the province (not including Hamilton-Wentworth).

3). The above six plants will be funded 50 percent by the Province.

4). The above plants will be operated by the Province.

5). By 1980 small municipalities will be assisted in replacing small landfill sites with transfer stations. These transfer stations will deliver waste to area resource recovery plants - to be fully operational between 1985 and 1990, and which are intended to reduce landfill requirements on a per-capita basis by more than 80 percent.

6). The area plants may be operated jointly by the municipalities served, or by private enterprise.

7). Private enterprise will be encouraged to accept recycled materials.

8). The Ontario Waste Management Advisory Board will be established. Its function is to recommend methods of reducing solid waste production through packaging product design improvement and to facilitate recycling and reclamation.

SWARU Experience and the Environmental Ministry Policy to Recommend Solid Waste Management Systems

In our opinion the proposed system of solid waste management for the Region is generally in accord with the present policy of the Ministry of the Environment and recognises the operational experience at SWARU.

The proposed system can and should be designed so that a 'front end' system of materials recovery can be added to each baler installation. The 'front end' system would probably consist of primary and secondary shredding, ferrous metal removal and air classification. The Provincial policy envisages that such installations will be fully operational between 1985 and 1990.

The design lifetime of the recommended scheme with the exception of the Glanbrook Disposal Site ends in 1985. We envisage that towards the end of that period the Region should either develop markets for the sale of reclaimable materials, or enlist the assistance of the Province or Private Enterprise to do this, so that a proven resource recovery system can be added onto the baler transfer stations in accordance with the Provincial timetable.

Why Not Now?

The obvious question to the above course of action is 'Why should the Region not install a resource recovery system at this juncture, and remain in the forefront in the field of solid waste management?'

In our opinion, the six initial materials reclamation plants to be constructed with the financial assistance of the Province, and to be operated by the Province may be considered full scale models of the long-term scheme of solid waste management for Ontario.

Clearly it would be unwise to install unproven plants across the Province at this time. The experience obtained with the model plants will mean that 'second generation' installations are likely to function more efficiently and present fewer

operational problems. It is our recommendation that the Region of Hamilton-Wentworth wait until the operational experience from the six initial installations is available, and then proceed with a 'front end' system of its own. This course of action will not only result in a more satisfactory materials recovery system, but will result in a greatly reduced debt load on the Region at this time.

6.3 Summary

1). The recommended system is not contrary to the Ministry of the Environment's policy on resource recovery, but provides for the Region meeting the Ministry's timetable with a more efficient 'second generation' installation.

2). The Region has gained valuable experience for the solid waste industry with SWARU. The cost of this experience has been borne entirely by the City and Region. Other authorities should bear the cost of gaining similar experience with materials recovery processes.

7. WRITTEN BRIEFS SUBMITTED BY THE PUBLIC

7.1 Introduction

As a part of the public participation programme, an advertisement was placed in the 'Hamilton Spectator' inviting written briefs commenting on the Solid Waste Management System proposed in our Sixth Interim Report. The names of the individuals and groups and summaries of each of the submissions are shown in Appendix 'B'. The summaries in the appendix are shown in a different order from the list of names.

7.2 Identification of Areas of Public Concern

It would be a large task to enter into detailed correspondence with each of the individuals and groups relative to each of their briefs. We have therefore, summarized the concerns and attempted to respond to each of them in this section of our report. While our summary cannot be complete, this approach means that at the very least we have addressed ourselves to the great majority of the concerns raised in the written material.

Of the thirty-three written briefs noted in Appendix 'A', twenty-five relate directly to the proposal to locate a landfill

site on Paddy Green Lane in Ancaster. Our present recommendation that this proposal be abandoned should therefore reduce some of the public concern with respect to the plan.

7.3 Environmental Problems Associated with Landfill Projects

The majority of the briefs cite environmental problems with existing 'landfill sites' and postulate similar problems with the balefill site proposed in Glanbrook and the landfill site formerly proposed in Ancaster.

These concerns may be summarized as follows:

Landfill Sites
- Eliminate productive farmland
- result in water pollution, rodent and bird problems
- are unacceptable as a long-term solution to the solid waste management problem
- should not be located in or close to a Conservation Area
- should not be initiated until floodline mapping has been undertaken in the immediate vicinity
- should not be conceived without a plan for end use.

Design and Operation of the Balefill Site

Many of the problems anticipated by the public relative to a proposed landfill or balefill site are based on past experience

with dumps. In the past, solid waste has often been disposed of at dumps where little or no covering of the material has taken place. Fires, vermin, birds and wind-borne litter have been very real problems.

The implementation of the proposed scheme will result in a single balefill site. This project will bear little resemblance to the 'dump' system that has been practiced in the past. The bales will maintain a high degree of integrity and blowing litter will be minimal and controlled within the site. In addition, there will be no fires and birds and vermin will not be attracted. Notwithstanding this, it is our recommendation that the pest situation be continuously monitored, and that appropriate control action be taken if necessary, however, past experience indicates that such action will not be necessary.

Leachate Problems

The concern with respect to water pollution again relates to previous practices at dumps and landfill sites. It is only relatively recently that the potential for water pollution associated with landfill sites has been fully understood. We have taken great care in our study to identify those areas of the Region where landfill sites are and are not practical due to ground conditions. In our opinion a balefill site can

be implemented at the Glanbrook location without adversely affecting the ground and stream water in the area. This will only result from designing the site with such a goal in mind and subsequent careful operation.

Leachate monitoring stations will be installed throughout the balefill site and the leachate situation will be monitored continuously so that any problem can be rectified before groundwater or surface water is affected.

It is perhaps necessary to emphasize that the present concept and the subsequent detailed design are strictly in accordance with the requirements of the Ministry of the Environment. Approval of the project will only be given by the Ministry once it has been proven that the design is to their satisfaction.

As is detailed elsewhere in this report, balefill sites have lower leachate generation characteristics than do conventional landfill or shredded waste sites. This is a significant advantage, and one of the main reasons why a balefill site is recommended.

Use of Prime Food Producing Land for Solid Waste Disposal

It is redundant to state that the conversion of agricultural land to landfill eliminates food producing land. In the long

term we agree that there will probably be a movement away from landfill techniques to methods of energy and material reclamation.

We recommend that the Region invest in a balefill disposal site that will have an estimated life of approximately fifteen years if present population trends and waste generation characteristics continue, and if no materials recovery process is instituted. Towards the end of this design period we anticipate that the Region will institute a method of solid waste management and processing that does not rely as heavily on land disposal as does our presently recommended system. The rate of removal of farmland for refuse disposal may therefore, be expected to be reduced towards the end of the next decade. In the interim period it is our recommendation that the Region lease back for agricultural purposes, the sections of the Glanbrook site that will not be used immediately for balefill. As the site is rehabilitated, agricultural activities will also be possible on the rehabilitated sections of the site.

While most of us would like to avoid landfill methods of solid waste disposal if reasonably possible, it should be remembered that the Region is already in possession of a low residue producing innovative disposal system (SWARU). The existing system, even if it were to operate at its design capacity, would only be capable of handling one fifth of the Region's estimated 1985 waste stream.

The capital cost of the SWARU system per ton of waste capacity is about five times that of the recommended system. In our opinion it is unreasonable to expect the Region to rely on a high capital cost and relatively unproven method of solid waste management in the immediate future.

At the best, this course of action would result in higher capital and operating costs than the recommended system and at the worst, it would result in an untenable situation where the Region possesses a partially workable system which is only capable of processing a part of the Region's waste production.

Proximity of the Balefill Site to Conservation Areas and End Use

In our opinion the distance of the proposed balefill site from a Conservation Area has a significant effect on the possible end use of the site.

Although the public generally perceives the concept of locating the balefill site close to the Binbrook conservation Area as undesirable, in the long term it might possible have been better to select such a location. The site then

could have been developed for active recreational purposes such as a ski slope or snowmobile trail area without generating a large conflict with adjacent land uses. In the short term, however, we agree that conflicts would occur between recreational activities in the Conservation Area and the balefill operation. The balefill operation is, however, relatively quiet and in our opinion, these conflicts could be reduced to an extremely low level by proper planning and control of the operations in and around the balefill site.

It is our recommendation that the balefill be located as previously shown, in the south-east section of Glanbrook. This location will minimize conflict with Conservation uses during the balefill operation but necessitates an end use that will not generate large amounts of traffic in the area and activities that are in conflict with the adjacent agricultural land use. For this reason it is our recommendation that when the site is developed, a volume of soil equivalent to five feet of cover be set aside. Once the balefill is complete, it should be covered with this material and planted with an appropriate mixture of tree species, or returned to agricultural use.

7.4 Proposals Relating to Alternative Solutions

Many of the public submissions suggest that the balefill proposal does not take advantage of present day technology and that the Regional system should be oriented towards materials and energy recovery to a greater extent. Some of the specific proposals by the public are as follows:

Watts for Waste could be implemented at Nanticoke

SWARU should be expanded

A Composting system

More recycling

While each of the suggestions, with the possible exception of composting, is feasible in the long term, each will result in relatively high capital expenditures combined with uncertain future income, together with a relatively unproven disposal system.

The recommended system provides for the disposal of approximately 1,000,000 tons per year, and a capital expenditure of approximately $10,000,000. Construction costs for facilities equivalent to SWARU of the same capacity would be in excess of $50 million, and the operating costs would be relatively indeterminate due to the unknown revenue from sale of materials and energy. Operational problems in future SWARUs would probably be less than are presently being experienced in the East Hamilton facility due to the experience that has been gained there. However, in our opinion the Region should not be the authority to test further relatively unproven methods.

The recommended system is flexible enough that 'front end' separation can be added to the baling system at a future date, in addition, if a different disposal system is adopted for the period following 1985, the balers can act as a backup should a subsequent system fail to operate.

7.5 Other Concerns

Several other concerns were raised with respect to the proposed system. We have attempted to answer these separately as follows:

Concern:

'No decision on the balefill should be made until the airport location is resolved'.

Response:

A properly operated balefill site should not generate a bird problem. The lack of capacity of existing disposal facilities in the Region requires that a decision on a solid waste management system be made in the immediate future.

Concern:

'Adjacent property owners and owners along the trucking route should be paid compensation'.

Response:

While it is easy to sympathize with persons who

live adjacent and on the route to the proposed site, financial compensation cannot be seriously considered by the Region. Almost every act that government makes -- preparation of an Official Plan, re-zoning land, constructing a road, sewer or watermain, etc. -- can be construed as benefitting or being to the detriment of many individuals. It simply is not practical or proper for compensation to be paid in such cases, or in this case. An additional consideration is that the 1985 estimated volume of 113 return trips to the Glanbrook balefill will represent a very small proportion of the traffic on Highway No. 56.

Concern:

'Glanbrook should be compensated for loss of taxes due to depreciation and elimination of farmland'.

Response:

The cost of operating a municipality is not directly related to assessment. If certain individuals are able to obtain assessment reduction due to the balefill operation, if all other factors remain constant, the total assessable value of property will decrease and it will be necessary to increase the Glanbrook mill rate. A redistribution of the tax load will have occurred and those individuals who have not obtained a

reduction in assessment will be subject to higher taxes. In our opinion, this is a reasonable situation since the persons paying higher taxes have a higher assessment, and no compensation by the Region should be made in this regard.

The question as to whether the Region should pay taxes to Glanbrook on the land that is to be a balefill site is a somewhat thornier problem. If it does not, for constant conditions it will be necessary to raise the Glanbrook mill rate. Generally, however, other government levels, schools, and churches are not subject to taxes, and in addition to placing a service load on the municipality, for constant conditions they remove assessment and generate mill rate increases. The balefill site will require minimal services by the Township of Glanbrook. However, if no taxes are paid, a slight mill rate increase will be necessary. While not wishing to evade this question, it is somewhat outside the field that should be answered by the Region's technical consultant. For this reason, we suggest that if the Township of Glanbrook still feels that compensation should be paid for this item, that this matter be resolved at the political level.

Concern:

'Access to the Glanbrook site should be via Highway No. 56'.

Response:

Highway No. 56 is our recommended access route.

Concern:

'A scoring system should have been used to select the balefill site'.

Response:

Admittedly a scoring system would have been a valid approach to selecting a location for a landfill site. The problem with such a system is that there are no universally accepted weights for the various factors that must be taken into consideration. Invariably when such an approach is taken, an argument develops regarding the number of parameters used in the system and the weights given to each of the parameters. We feel that the approach taken in this study was reasonable and realistic and has resulted in an implementable solution. While we have not rejected the electronic computer as an assistant in the study, we have attempted to prevent it from becoming the oracle. If generally accepted scoring guidelines had been developed, we would agree that the scoring method would have permitted the detailed evaluation of a very large number of potential sites.

Concern:

'No emergency garbage situation exists'.

Response:

With the exception of SWARU, the useful life of all the existing disposal facilities has almost expired. Several of the 'dump' operations present significant environmental hazards such as water pollution, fires, rodents, etc. The Ottawa Street site is located on land that is generally undesirable for landfill purposes, and in addition, it is subject to encroaching relatively dense urban development. The design capacity of SWARU is 600 tons per day. The present capacity requirement for the entire Region is approximately 2,500 tons per day. Given these facts, in our opinion, a decision should be made in the immediate future relative to a solid waste management system.

Concern:

'Each municipality should look after its own garbage'.

Response:

Much of the public concern that has been expressed has been as a result of previous negative experiences with solid waste disposal systems. In our opinion, a fairly large scale operation is necessary to meet present day environmental requirements, and it is not practical or economical to meet these criteria on a small landfill site in a small town or

township if a Regional facility is possible (of course, in isolated areas, small facilities are obligatory). In addition, the land in Flamborough, Dundas and much of Hamilton and Stoney Creek is not suitable for landfill sites. The only suitable land is in the southern parts of Ancaster and Glanbrook. Clearly if new sites were to be established in all of the municipalities, many would be on land not suitable for landfill.

Concern:

'What will the height of the balefill at Glanbrook be?'

Response:

The land area required has been determined by assuming that 40 feet of garbage bales will be deposited. The bales are 4 feet thick and 6 inches of earth cover is required between each layer. 5 feet of cover will be provided on the top, and thus the total height would be 50 feet. We would anticipate designing the site with contours so that it does not appear simply as a block 50 feet high.

In order to reduce the height, it is possible to excavate to a depth of approximately ten feet before placing any bales. This would require trucking of earth away from the site. The depth to which it is possible to excavate can only be determined following a detailed geological investigation of the site.

Concern:

'The problem should be turned over to private enterprise'.

Response:

While there can be no question that it is a government responsibility to ensure that solid waste is disposed of safely and without creating environmental problems, it is clear that very sophisticated methods of solid waste management will be appropriate before the end of this century. Considerable risk is associated with the development of such projects, and it is our view that this risk should be borne by private enterprise or senior government, and not by municipalities. In this way, authorities such as the Region will not be required to invest in systems which may or may not work as designed and be subject to large unplanned capital expenditures and operating costs which jeopardize other essential services that the municipality undertakes.

8. HYDROGEOLOGICAL ASPECTS

The soils and hydrogeological aspects relative to our recommendation for a balefill site have been dealt with in some detail in the Sixth Interim Report, and are also the subject of the final Gartner Lee and Associates Limited report which is submitted simultaneously with this document.

To date, the capability of using the Glanbrook site for balefill purposes has been assessed by interpreting air photographs and Ministry of the Environment water well records, by visual inspection and by reviewing the available literature on soils characteristics and agricultural capability.

Drawing No. 5 shows that the lands in the southern parts of the Township of Glanbrook and the Town of Ancaster are the most suitable in the Region for landfill purposes.

Drawing No. 6 shows the terrain features of the proposed Glanbrook balefill site and vicinity. Parts of the site are occupied by flood plains. These areas are not suitable for landfill purposes, and it is our recommendation that these areas not be used for the balefill operation.

In order to confirm the conclusions arrived at during the preliminary hydrogeological study, it is our recommendation that a detailed drilling investigation of the site be carried out as soon as possible.

If at all possible, permission to drill boreholes should now be obtained from the existing owners of the lands.

The subsurface study can then be carried out and a report can be prepared detailing what measures are necessary to meet Provincial standards for the operation of a balefill site at the Glanbrook location.

APPENDIX 'A'

TERMS OF REFERENCE

APPENDIX 'A'

TERMS OF REFERENCE
FOR THE ORIGINAL
WASTE MANAGEMENT STUDY

Preliminary Report

The Consultant shall be provided with a copy of the 'Preliminary Waste Management Study Wentworth County and Adjacent Area'. This document is provided for information only and shall not be construed as any indication as to the area to be served, the facilities to be employed or in any way as an indication as to the wishes of the participating municipalities.

Study Area

The primary purpose of the report shall be to review existing waste management facilities in Wentworth County and the City of Hamilton and to provide a plan for a waste management system serving the same area. The Consultant however shall not be constrained by this intent. If, during his investigation, it is determined that by going beyond the boundary of the County of Wentworth a more viable waste management system can be developed then he shall be at liberty to expand the study area to allow such a plan to be developed.

Existing Waste Management Systems

The Consultant shall examine all existing waste management systems in the study area. The features examined shall include all collection and transportation services, and all disposal facilities whether they are municipally owned and operated or privately owned and operated.

Services to be Examined and Provided

The Consultant shall examine all waste management systems presently handling the following wastes:

a). Wastes collected by 'domestic collection services'
b). Wastes collected by 'commercial collection services'
c). Wastes collected by 'solid industrial waste collection services'
d). All disposal facilities handling wastes described in (a), (b) and (c) above.

The waste management system recommended by the Consultant shall be designed to accept these wastes for collection, treatment and disposal.

Other Wastes

The wastes to be handled by the planned waste management system are detailed in the preceding section. The Consultant however shall examine the need for providing facilities for liquid industrial waste and shall make a recommendation as to whether these facilities, if required, shall be incorporated into the waste management system planned and recommend by him.

Recommendations

The Report shall include, as detailed above, the following:

a). A recommendation as to the area to be served by the waste management system.

b). Recommendations as to the methods of collection, transportation treatment and disposal to be incorporated into the system.

c). Provide comparative costs estimate for different systems, different system components and cost projections for ten years based on system expansion and increased demand for service.

d). The Consultant shall recommend which system should be implemented. The recommendation shall include an estimate of capital expenditures, operating and management costs. The system shall be designed to serve the area for a period of not less than 20 years.

e). The Consultant shall make recommendations as to the apportionment of cost for establishing and operating the waste management system and shall include a recommendation as to the management system and procedures to be adopted in the interests of equity and efficiency.

The Consultant will be required to provide 50 copies of the Report.

APPENDIX 'B'

DETAILED TERMS OF REFERENCE FOR THE CONTINUATION OF THE HAMILTON-WENTWORTH WASTE MANAGEMENT STUDY LEADING TO THE DEVELOPMENT AND IMPLEMENTATION OF A SOLID WASTE DISPOSAL PLAN

APPENDIX 'B'

DETAILED TERMS OF REFERENCE FOR THE CONTINUATION OF THE HAMILTON-WENTWORTH WASTE MANAGEMENT STUDY LEADING TO THE DEVELOPMENT AND IMPLEMENTATION OF A SOLID WASTE DISPOSAL PLAN

The Consultant shall carry out the following work:

1. Develop a solid waste disposal plan for the Region based on the following goals and objectives:

   a). To plan for a co-ordinated, orderly, and efficient solid waste management system that will optimize the cost/benefit relationship on a regional basis.

   b). To maintain a high standard of operation in the total waste management system to ensure an acceptable level of public health and safety.

   c). To minimize adverse environmental impact in the transfer of waste, as well as in the selection, operation, and termination of any disposal area. In this respect concern is for both natural and man-made environments.

   d). To evaluate both the technical and economic feasibility of recycling and/or recovery of solid wastes and to be alert to when these activities should be encouraged within the region.

   e). To locate future disposal areas with a view to their probable end use as open space, recreation areas, etc. so that these facilities are optimally placed within the region.

2. On the basis of the information contained in the three interim reports presented by Proctor & Redfern Limited, prepare details of at least two viable proposals for a waste management system for submission to the Engineering Services Committee with a view to having the committee recommend one proposal to the Regional Council.

The tasks to be carried out prior to the submission of the two proposals are, but not necessarily limited to, the following:

a). Additional Data Collection and Analysis

i). Prepare a complete inventory of all candidate areas in the Region upon which model sanitary landfill operations can be established. This inventory should include all defunct quarries, wasteland areas, marginal farming lands, etc., as well as existing disposal sites.

ii). Prepare comments as to the potential of each of the candidate areas for use as a disposal site, listing the pros and cons. Geological and environmental impact factors should be listed and their importance weighed.

iii). Examine the previously collected data to determine the fractions of the total solid wastes to be disposed that are putrescible and non-putrescible.

iv). Identify the manner in which all wastes are collected and hauled to the disposal sites. Determine the ease that changes in the manner of collection and hauling can be made so as to determine the possibility of separating the inert components from putrescible components of the waste.

b). Functional Design of System

i). Determine in general the engineering requirements for properly establishing model disposal operations in each of the candidate sites. This should cover, among other things, leachate control and gas venting systems, ground water pollution, monitoring systems, roadway access, drainage, site facilities, etc. These requirements should vary from site to site and should vary depending upon the waste materials to be disposed.

ii). Determine practicability of employing various process techniques in each of the sites and their impact upon the sites with respect to life, size and end use.

iii). Determine engineering requirements for haul to the disposal site(s). Here the economics of transfer station(s) should be considered in comparison to direct haul to the disposal site(s). Specific locations of the transfer station(s) should be considered as should the type of waste material to be handled and size of facility to be constructed.

iv). End uses of each candidate disposal site should be suggested and sufficient details should be provided for costing, etc.

v). Preliminary cost estimates should be developed for each of the items examined above.

3. Provide the following information on at least two viable proposals for the consideration of the Committee.

i). Capital Costs of 'Regional' works.

ii). Annual operating cost for 1975 of 'Regional Works'.

iii). Total cost of all of the elements of the management system.

iv). Level of service provided by each proposal.

v). Life-time of each proposal.

vi). Environmental impact of each system.

vii). Potential for establishing a feasible recovery or recycling operation.

viii). Potential for conversion to waste management systems likely to become feasible over the design period (20 years).

Drawings, charts, etc., as well as explanatory text should be provided.

4. Upon acceptance by the Committee of one of the systems developed above, prepare a detailed master plan for implementing the recommended system. This should include the phasing out or the improving of existing operations. Specific property requirements as well as capital works budgets should be prepared. Consideration should be given to the calling of tenders from private companies for any or all of the elements in the recommended

system. Recommendations on manpower and machine requirements should be presented. Existing disposal 'fees' should be examined and evaluated in the light of the level and cost of the services provided.

5. Interim Reports shall be presented at appropriate stages, such as the completion of main tasks. Drafts of these reports shall be explained to and scrutinized by the Technical Committee before presentation to the Engineering Services Committee. The interim reports would be presented to the Regional Council 'for information' and should be tabled 'as received'.

6. Initiate a public information programme after approval of the proposed programme by the Engineering Services Committee.

7. Attend any Environmental Board Hearings on behalf of the Regional Council.

8. Submit 50 copies of the details of the proposed waste management systems for the consideration of the Engineering Services Committee.

9. Upon acceptance by the Engineering Services Committee of one of the proposed systems submit 50 copies of the detailed master plan of the recommended system.

10. Maintain close liaison with the Commissioner of Engineering and the Ministry of the Environment throughout all phases of the study.

APPENDIX 'C'

STATE OF THE ART
OF INNOVATIVE
SOLID WASTE MANAGEMENT METHODS

1. General

The scheme recommended in this report has been designed to be 'fail safe' as much as is reasonably possible. In the unlikely event that all of the balers become temporarily inoperative, loose waste could be hauled directly to the Glanbrook Site and loose-landfilled. Similarly, should the Dundas Transfer Station become temporarily inoperative, wastes could be hauled directly to either of the balers, or even to the Glanbrook site. Of course, loose landfilling at Glanbrook is not as desirable as balefill, but since the alternative would be no disposal at all, in our opinion, this alternative is acceptable for a limited period of time.

In the following pages we have reviewed several innovative methods of solid waste disposal. It is almost inevitable that all such processes will be inoperative at some period during their useful life and for this reason a backup system should be provided. Since all the systems produce a varying proportion of residue which must be landfilled, it is logical that the backup system be a landfill site.

The likelihood that all balers in the recommended scheme would be inoperative at any one time is extremely low, since the three balers (two at east Hamilton and one at Upper Ottawa Street) will be mechanically independent. If one of the balers becomes temporarily inoperative we would envisage a redistribution of the baling load

to the other available facilities, and the working of longer shifts.

If, however, the disposal system were to be a large single facility such as a pyrolysis plant, no such redistribution of the load would be possible, and either all wastes would have to be hauled to the landfill site directly, or a backup system would absorb some of the load .

In order to make the systems comparable we have made the judgment that a backup system should be capable of handling all normal residue from any process, and in the event of failure of the process, the backup system should also be able to handle the residential portion of the wastes. All other classes of waste would be direct hauled to the landfill site in the event of failure of the main system.

In our cost estimates for each of the systems that follow, we have therefore, reflected the cost of such a transfer system.

2. Sale of Energy and Materials

Many of the processes appear to be very attractive from a financial point of view when revenue from the sale of energy and materials is taken into account. Conversely, the processes are very unattractive when such revenue is not available. We have therefore, shown estimated costs for both situations. In our opinion, it is most important that markets be developed for the sale of the products of

these processes prior to a major financial commitment being made for construction. Such a market has not yet been developed in Hamilton-Wentworth, and, paradoxically, it would probably be very difficult to develop such a market unless it could be shown that the proposed system is reliable.

Whether revenue is available from sale of energy and materials or not, an extremely high capital investment is necessary to construct a large waste processing plant. The influence of this investment on the Region's overall Capital Debt would be very significant, and for this reason, together with the others cited above, we feel that any future innovative processing system should be financed by private enterprise or a senior level of government, so that the Region has sufficient borrowing power to carry out other essential services.

3. Review of Innovative Disposal Systems

3.1 Pyrolysis

This is one of the more promising solid waste disposal processes, depending on the particular method, the waste, which may include large items such as refrigerators and washing machines, is shredded and then classified by various methods. The reactive portion is heated in the absence of air or in an air-deficient atmosphere, combustible gases, oil, 'char', and ash are produced in varying quantities.

Existing Plants

All existing pyrolysis plants are of the pilot type. Although full scale plants are under construction, no full scale operational experience is available.

a). Monsanto System

A 35-tons per day plant was constructed near St. Louis in 1969. Continuous operation was obtained by 1970. The plant was dismantled in 1971. The process consisted of shredding, heating in a rotary kiln with an air-deficient atmosphere and heated partially by supplementary fuel. Ferrous metal is separated in the process.

The products of the process are as follows:

1). Combustible Gas which is used to generate steam

2). Ferrous Metal

3). Glassy Aggregate, which may be used for road construction

4). Char, which consists of approximately 50 percent carbon. Uses for this material have yet to be developed.

b). Garrett System

A 4 tons per day plant was constructed in Vancouver, Washington in 1971. It was shown to be able to handle a waste stream and is still in existence and used for occasional

tests. The process consists of a complex system of primary and secondary shredding, and classification by the use of air and other means. The objective is to eliminate non-organics prior to the pyrolysis process. Pyrolysis takes place in a vertical stainless steel pipe.

The products of the process are as follows:

1). Oil which has a heating value of approximately 50 percent that of domestic oil

2). Ferrous Metals

3). Glass

4). Char

5). Gases (partially combustible - used as fuel in process)

c). Torrax System

A 75 tons per day plant is in existence in Buffalo, N.Y. The plant is operated intermittently for test purposes.

In the process, all waste enters the reactor directly. The material is placed in a vertical shaft into which air heated to approximately 2,200° F. is introduced. Gas is produced which may be used to produce steam, or directly as a fuel. In addition, a slag is produced which is about 25 percent by weight of the incoming stream of domestic refuse.

Natural gas is used as a supplementary fuel to heat the air stream, although it is claimed that this would not be necessary in a commercial sized plant.

d). Other Systems

There are a few other pilot plants in existence or under construction. Each one is similar to one of the above processes.

Plants under Construction

Two major full scale pyrolysis plants are under construction - one in Baltimore, Md., and one in San Diego, California.

1). Baltimore, Maryland

A 1,000 tons per day Monsanto system plant is under construction in Baltimore.

The estimated capital cost of the project is $16 million. The amortization cost of this sum over 20 years would be approximately $1,875,000 per year (based on 10 percent interest) or $6.00 per ton.

Operating costs are estimated to be $7.60 per ton, thus the total operating cost is estimated to be $13.60 per ton. The revenue is estimated to be $13.13 per ton - from the sale of steam, ferrous metal and glassy aggregate, and thus the

estimated net operating cost of the plant is very low - approximately 47 cents per ton.

2). San Diego, California

A 200 tons per day Garrett system plant is under construction near San Diego. The total capital cost is estimated to be $6,344,000.

Amortization over 20 years at 10 percent would be approximately $745,000 per year, or approximately $12.00 per ton. The operating cost is estimated to be $916,000 per year, or approximately $14.75 per ton for a total cost of $26.75 per ton. Revenue is expected to be approximately $628,000 per year, or approximately $10.10 per ton, for a net operating cost of $16.65 per ton.

Cost of a Pyrolysis System for Hamilton-Wentworth

The 1985 waste production for the Region is estimated to be approximately 1,000,000 tons per year. A pyrolysis plant to handle this load may reasonably be expected to cost in excess of $60,000,000. The operating cost including amortization would be between $13. and $30. per ton of wastes assuming that the plant operated as designed. If not, the operating costs could be much higher, and there would be problems in disposing the untreated wastes.

Revenue between zero and $12 per ton of wastes for the process products may be anticipated. The higher estimate of revenue is probably optimistic, as, probably is the lower estimate of operating costs. If, for example the real operating cost was $20 per ton and the real revenue $5 per ton, the net cost would be $15 per ton. This compares with approximately $4.50 per ton for the actual baling operation in the recommended system, thus for a pyrolysis system a capital expenditure of approximately $60,000,000 would be required for a total Regional disposal cost of approximately $20 per ton. The recommended system requires a capital expenditure of approximately $10,000,000 and results in a Regional disposal cost of approximately $11 per ton. It also has the advantages of flexibility and having been proven on a large scale basis.

3.2 Incineration and Heat Recovery

There are relatively few examples of this concept in North America, although several projects are presently under study. In the following section a brief review will be made of three projects, two of which are in existence, and one of which is to be implemented shortly.

1). Nashville Thermal Transfer Corporation

A non-profit corporation was established in 1970 to construct and operate a solid waste burning-steam generation plant. The plant

is intended to handle 720 tons per day of waste. Its capital cost has now reached $24.5 million. The residue is approximately 30 percent of the incoming material by weight and the design capacity for steam production is 216,000 pounds per hour. Present revenue is approximately $4.65 per 1,000 pounds steam. Operation costs were not stated in a recent paper describing the project.*

The amortization cost of the project would be approximately $2,890,000 per year, or approximately $13.40 per ton of waste.

Revenue would be approximately $7,000,000 per year at the stated capacity.

Unstated costs include operational and residue disposal costs.

2). SWARU, Hamilton, Ontario

SWARU was completed about three years ago. Its rated capacity is 600 tons per day. Its capital cost was approximately $9,000,000 - amortization over 20 years at 10 percent would be approximately $1,050,000 per year or $5.44 per ton. Operation costs are approximately $1,250,000 per year or approximately $6.50 per ton. No revenue has been earned from the sale of the steam that the plant generates. The actual operating capacity of the facility has

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* Nashville Thermal Transfer Corporation - A Status Report - International Public Works Congress and Equipment Show New Orleans, Sept. 20-25, 1975

been found to be considerably less than 600 tons per day due to operational problems.

3). Watts from Waste, Toronto, Ontario

The Watts from waste system will generate electricity from solid waste at the Lakeview Generating Station in Toronto. The system consists of a transfer station, a pulverizing and separation plant and modifications to the boiler systems at the generating station. In 1973 the total capital cost of the system was estimated to be $15 million, or about $20,000 per ton-day of capacity.

The pulverized waste is mixed with the normal coal feed into the boilers, and it is hoped that the relatively low percentage of waste will not cause corrosion problems. This has been borne out by experience at a similar project at St. Louis, Miss.

The operating costs of the system are expected to be approximately $12.00 per ton of waste (excluding amortization) with an income of approximately $4.00 per ton of waste for the fuel value of the waste and the sale of ferrous metal.

Cost of an Incinerator - Heat Recovery System for Hamilton-Wentworth

A capital investment of approximately 50 million dollars would be required compared with approximately $10,000,000 for the recommended scheme. Assuming that the system operates as designed, a total Regional cost of about $17.50 per ton of waste could be

expected. This could be offset by the sale of materials and energy. As with pyrolysis, the economics are quite attractive, but the disadvantages are the high capital investment required and the uncertainty as to the operational reliability of the system which is to handle the entire solid waste load.

3.3 Composting

Composting is a process whereby the organic materials contained in solid waste are encouraged to degrade in a biochemical process. The end product may be used as a soil conditioner or as a peat-like fuel, or as the base for products such as wallboard, building blocks or fertilizer.

In order that the biochemical reaction may take place under optimum conditions, the internal temperature of the material must be approximately 80° C. Under these conditions a volume reduction of 40 - 60 percent may be achieved.

Composting is not used to a great extent in North America, and where it has been used, it has often met with financial failure due to the lack of a market for the product. Its use as a disposal method in Europe varies from a negligable proportion of the waste stream to about 15 percent in the Netherlands. The method is widely used in India and there are large facilities in Iran and

including backup and disposal of non-biodegradables, assuming that the humus product can be sold or given away, rather than landfilled. In North America at this time it is impractical to assume any significant income from the sale of the product of composting.

4. Conclusions

Pyrolysis and Energy and Materials Recovery appear to be promising methods of solid waste disposal. Composting is of doubtful use in North America at this time due to the lack of usefulness of its product in high yield agriculture.

The three main disadvantages of pyrolysis and energy recovery are:

1). High capital investment required.

2). Lack of reliable operating experience on a large scale

3). Requirement of sale of products for economic viability.

We would anticipate that the use of these methods will become more widespread over the next twenty years as operational problems are eliminated and the value of the products rises. Before the end of the century we would envisage Hamilton-Wentworth relying to a much greater extent on this type of facility.

In our opinion, however, an innovative method is not appropriate at this time, as the immediate problem must be solved. Once

the Region has a satisfactory system, such as the one we recommend, in operation, consideration should be given to the long term solutions to solid waste management in Hamilton-Wentworth.

APPENDIX 'D'

Names of Individuals and Groups that Submitted Written Briefs to the Region

Mrs. J. Attwood

Ancaster Committee against Regional Landfill

Murray Aikens

Town of Ancaster

Bruce Bakewell

Binbrook Anti-Dump Committee

G.L. Burrows

S.K. Bonham

Dundas Valley Vagabonds

Federation of Environmental Groups

Township of Glanbrook

Glanbrook Residents Association

Mr. and Mrs. J. Green

Mr. and Mrs. C. Glass

Hamilton Region Conservation Authority

W. Haslam

Human Ecology Foundation

D. MacKay

Mrs. D. Matheson

Mr. and Mrs. J.H. Newell

T. Powell

Poem Authors

Bernard L. Poole

C. Salmon

Alex Sanderson

William J. Slate

Continued .....

N.L. Wilson

R.R. Wilson

Wentworth Federation of Agriculture and

Haldimand Federation of Agriculture

Mr. and Mrs. G. Hearsley

Wentworth North Womens Institute

J.P. Lynch

Summary of Items Raised in Each of the Written Briefs Received by the Region

1). Landfill uses valuable farmland

Material could be used at Nanticoke as in Watts for Waste

Cope Quarry could be used until Nanticoke

Trucking to Glanbrook $\$18 \times 10^6$ for 20 years - enough for two SWARUs.

2). SWARU should be expanded

SWARU should operate on 3-shift basis

Distribution of population used in study questioned

Scoring system should be used for site selection

No decision of balefill until airport resolved - bird problem

End use should be in final recommendation

Buffering should be developed with municipality and adjacent owners

All property owners should be paid 'depreciation'

Township should be compensated for loss of taxes due to landfill (also due in part to depreciation)

Access should be via Highway No. 56

Dwellings along route as important as adjacent to landfill

Floodline mapping should be undertaken together with studies of leachate control

Proposal is contrary to Ministry of the Environment policy.

3). Proposal contrary to Ministry of the Environment policy

- no reclamation.

Glanbrook site conflicts with airport and rural land use.

No emergency garbage situation exists.

There has been a lack of full disclosure.

Scope of study too restrictive.

No citizen or community should be expected to subsidize garbage disposal for the Region.

The study has many deficiencies.

The proposal will remove prime land from production.

There are sound economically viable alternatives.

4). Proposal will remove food-producing land.

Pollution of wells and streams may occur.

Problems with rodents, birds, etc.

Smoke will harm vegetables and fruit.

5). Leachate from Ancaster site would be a problem

- reach lakes - pollute wells.

500 years before site returns to natural conditions.

Compensation should be paid to adjacent farms and homeowners.

Roads inadequate.

Site opposite conservation authority land.

Trees would be removed.

Site is a lateral moraine with varying geological characterisitics

- not suitable for landfill

Does not make sense to bury fuel.

6). Ancaster site too close to Conservation Area.

7). Composting better solution.

8). Pollution from proposed Ancaster dump will cause problems for Agricultural activity.

9). Fires from dump will be visible over wide area.
Debris will be problem.
Consultants have conflicts of interest.
Fears for well
No real public participation.

10). Ancaster dump creates water and air pollution
Ancaster dump will use prime agricultural land.

11). Each town should look after its own garbage.
Ancaster dump too close to Conservation Area.

12). Endorses Conservation Authority's resolution.

13). Environmental impact study should be carried out for proposed Ancaster dump.
Consideration should be given to recycling.
Methods of leachate collection should be investigated.

14). Ancaster site highly productive farmland
Site is lateral moraine.
Will cause water pollution
Site is close to Recreational Area.

15). No indication of end use for sites given.

Poor public involvement - should have had citizens' sub-committee.

Balefill trucks will litter roads.

Birds will be attracted.

Height of balefill unknown.

Balefill trucks too large.

Groundwater will be contaminated.

Surrounding properties will depreciate.

Hamilton should institute recycling.

Permit for landfill should be on an annual basis - so that there is incentive to investigate new methods.

Each municipality should dispose of its own garbage.

SWARU: antiquated design.

Steam from SWARU should be sold.

Incineration better than balefill.

Composting could be a partial solution.

Soils tests should be done immediately on sites.

Glanbrook site in flood plain.

Trees must be removed for Glanbrook site.

Input should be received from Grand River Conservation Authority.

16). Ancaster dump will cause water pollution, is in scenic area.

17). Ancaster dump too close to Conservation Area, school and other facilities.

18). Ancaster site will cause water pollution.

19). Plenty of room for garbage in Dundas (Ancaster resident)

20). Ancaster site uses good farmland

Will cause water, air pollution and traffic problems.

21). Ancaster site prime farmland.

Runoff will pollute wells.

Moved to Ancaster to escape City problems - don't want City garbage.

Every municipality should look after its own garbage.

Problem should be turned over to private enterprise.

Cut down on packaging.

Have returnable pop bottles.

22). All we get from Region is higher taxes and garbage.

23). Ancaster unsuitable for dump

24). Ancaster site will pollute wells and remove prime agricultural land.

25). Ancaster site will pollute wells, cause litter and use prime agricultural land.

26). There will be fires, smoke, rates in site and garbage on the road around the Ancaster site.

Ancaster site will use prime agricultural land.

27). Ancaster site will use prime agricultural land and cause water pollution.

There is bound to be burning.

28). Ancaster site - as per (24), also traffic will be problem.

Land south of Jerseyville Road should be used instead.

29). Ancaster site is lateral moraine.

30). Sanitary landfill unacceptable as a long-term solution to waste management problem.

Hamilton-Wentworth should be in Provincial Reclamation Programme.

Provincial assistance should be available to upgrade SWARU.

Proposal does not present viable alternative methods.

Proposal does not indicate sites that have been discarded.

Proposal does not show site end use.

Proposal does not provide security for disposal of construction debris.

Binbrook site has streams and springs.

No truck statistics for 1987 - 1997.

Provincial assistance required.

31). Ancaster site prevents use for organic farming. Difficult to obtain organically grown food if converted to landfill.

32). Ancaster site is where crops are grown organically.

33). Roads not adequate for heavy vehicles.

Do not want problems of Ottawa Street dump (fires, rats, water pollution) in Ancaster and Glanbrook.

Selected Bibliography

(i) Waste Management Branch, Ontario Department of Energy and Resources Management.

May 1971 — Preliminary Waste Management Study Wentworth County and Adjacent Areas

(ii) Proctor and Redfern Limited, Consulting Engineers and Planners

May 1972 — Hamilton-Wentworth Waste Management Study, First Interim Report

(iii) Ibid

October 1972 — Hamilton-Wentworth Waste Management Study, Second Interim Report

(iv) Ibid

September 1973 — Hamilton-Wentworth Waste Management Study, Working Documents for Final Draft.

(v) Ibid

January 1974 — Hamilton-Wentworth Waste Management Study, Summary of Work Done to Date.

(vi) Gartner Lee Associates Limited

October 1974 — Hydrogeological Impact Study, Selected Potential Landfill Sites, Hamilton-Wentworth Region.

(vii) Proctor and Redfern Limited, Consulting Engineers and Planners

November 1974 — Hamilton-Wentworth Waste Management Study, Fifth Interim Report.

(viii) Ibid

February 1975 — Hamilton-Wentworth Waste Management Study, Sixth Interim Report.

Proposed Solid Waste Management System

Legend

- SWARU
- (B) Baler Station
- (T) Transfer Station
- G Proposed Glanbrook Balefill Site
- Escarpment
- C Construction Debris Disposal Site
- North Collection Area - Wastes To Swaru/East Hamilton Baler
- South Collection Area - Wastes To Upper Ottawa Street Baler
- West Collection Area - Wastes To Dundas Transfer Station

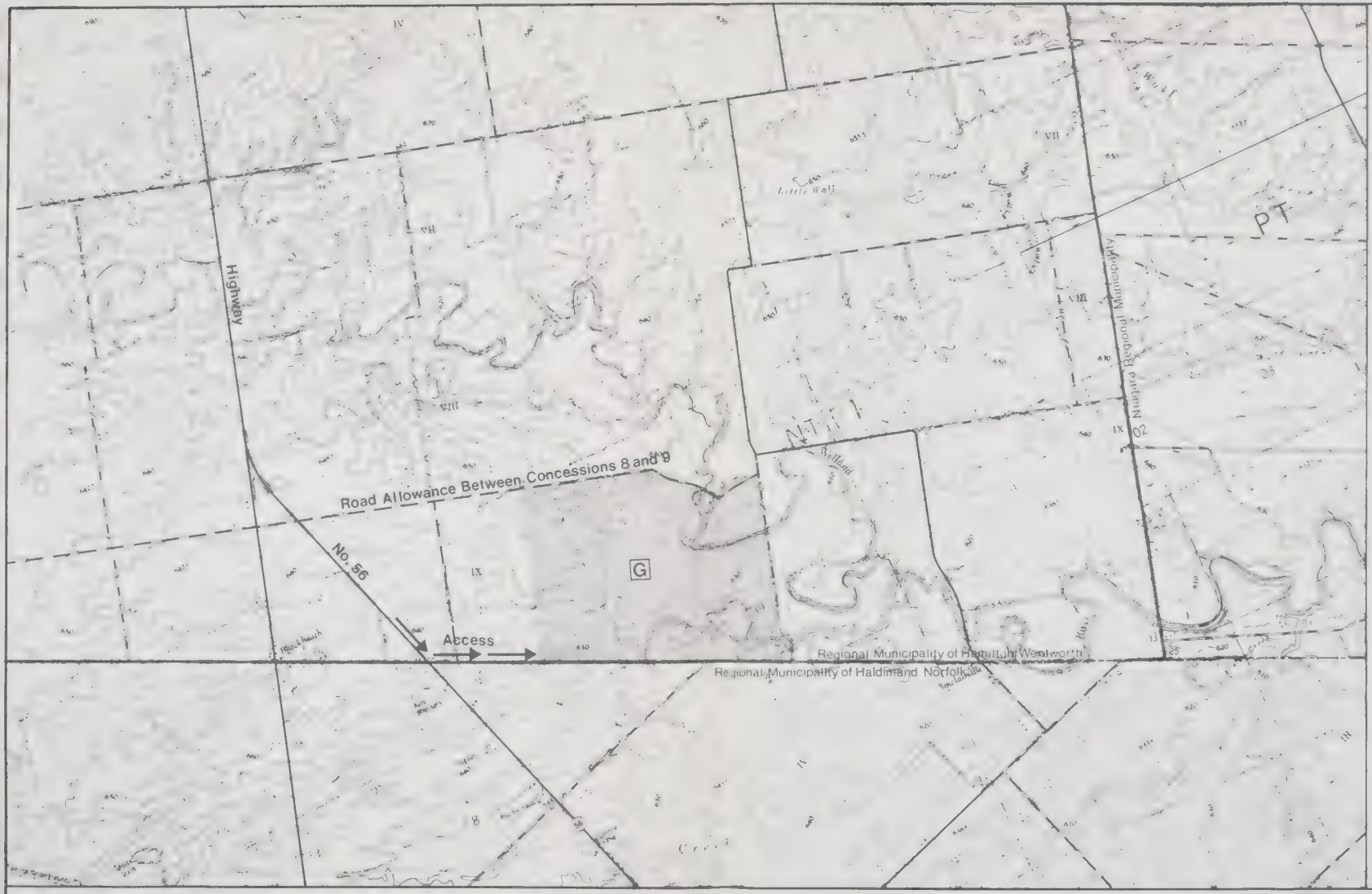
Hamilton-Wentworth Waste Management Study

Proctor & Redfern Limited
Consulting Engineers and Planners

Scale in Miles
1 ½ 0 1

Dwg. No 1

Jan 1975



Recommended Glanbrook Balefill Site

Legend

G Proposed Glanbrook Site

Gross Acreage 537 ±

Useable Acreage 250 ±

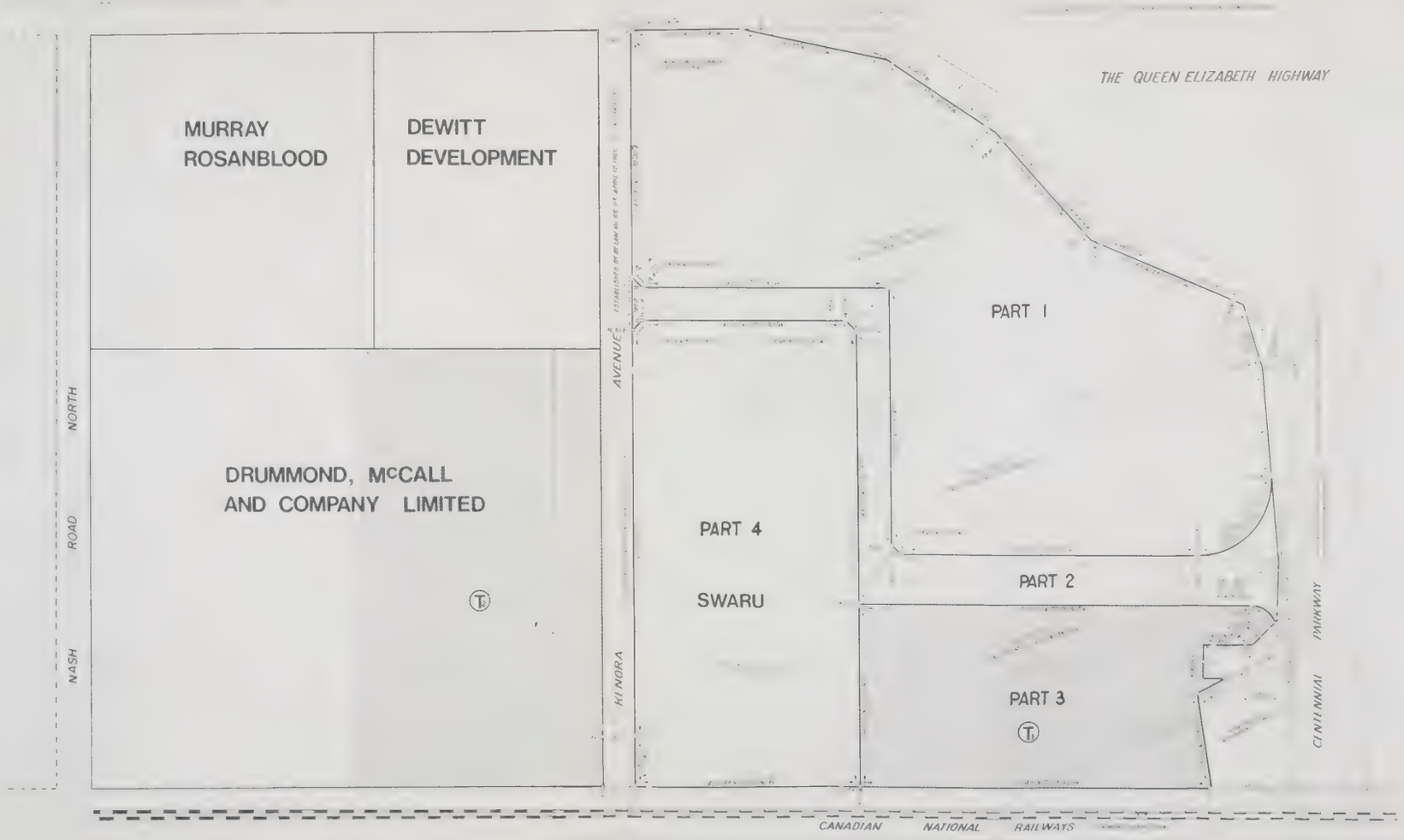
Hamilton-Wentworth Waste Management Study

Proctor & Redfern Limited
Consulting Engineers and Planners

Scale 1:25,000

Dwg No 2

Sept 1975



Alternative East Hamilton Baler – Transfer Station Sites

Legend

T1 Baler – Transfer Site Alternative 1

T2 Baler – Transfer Site Alternative 2

Hamilton - Wentworth Waste Management Study

Proctor & Redfern Limited
Consulting Engineers and Planners

Dwg No 3
Jan 1975

Quarries in the Region that may be used as disposal Sites for non-acceptable Wastes

Legend

(14) Existing Quarry

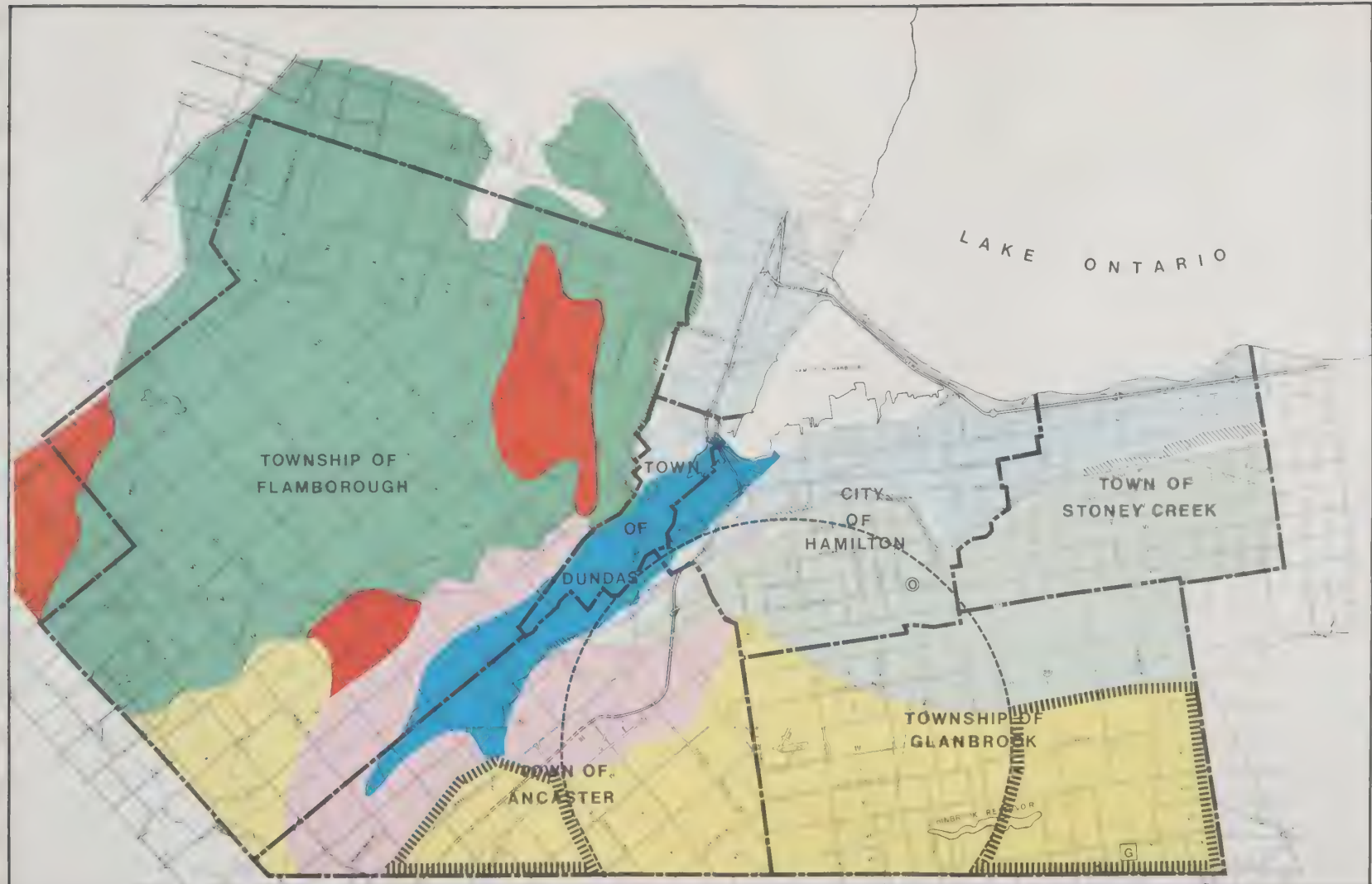
Hamilton-Wentworth Waste Management Study

Proctor & Redfern Limited
Consulting Engineers and Planners

Scale in Miles 1 1/2 0 1

Dwg. No 4

Jan 1975



Hydrogeological Conditions

Legend

SUITABILITY FOR SANITARY LANDFILL SITES

Most Suitable

'Reducing Suitability'

Least Suitable

SOLID WASTE DISPOSAL FACILITY

◎ Existing Upper Ottawa Street Landfill Site

G Proposed Glanbrook Balefill Site

------ 6 MI. RADIUS FROM MOUNT HOPE AIRPORT

AREAS MOST APPROPRIATE FOR MAJOR SANITARY LANDFILL SITES

Gartner Lee Associates Limited

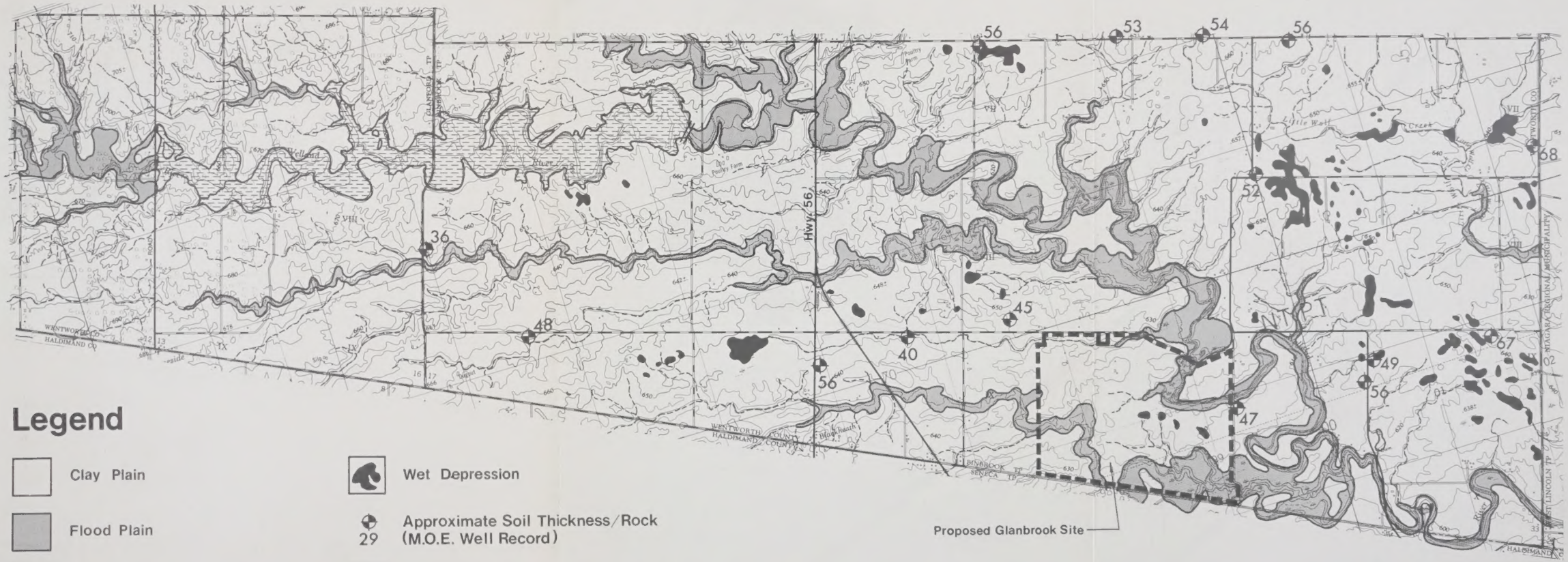
Hamilton-Wentworth Waste Management Study

Proctor & Redfern Limited
Consulting Engineers and Planners

Scale in Miles
1 ½ 0 1

Dwg. No. 5

Terrain Features - Glanbrook Site



Legend

- Clay Plain
- Flood Plain
- Lake
- Wet Depression
- Approximate Soil Thickness/Rock (M.O.E. Well Record) — 29
- Intermittent Stream

Hamilton-Wentworth Waste Management Study

Scale 1:25,000

Dwg. No. 6

Jan. 1975

Gartner Lee Associates Limited